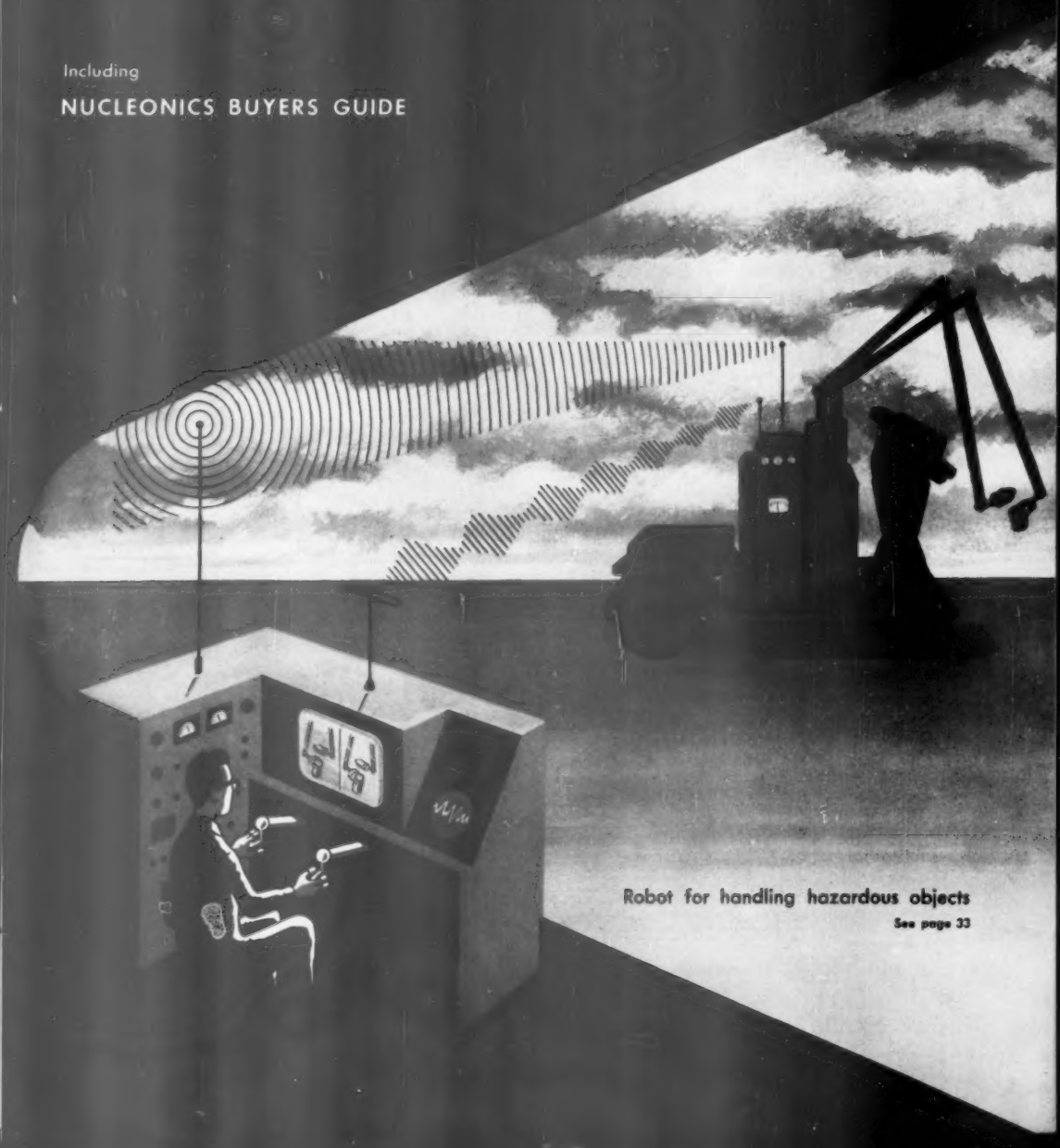
NUCLEONICS

Including

NUCLEONICS BUYERS GUIDE



Robot for handling hazardous objects

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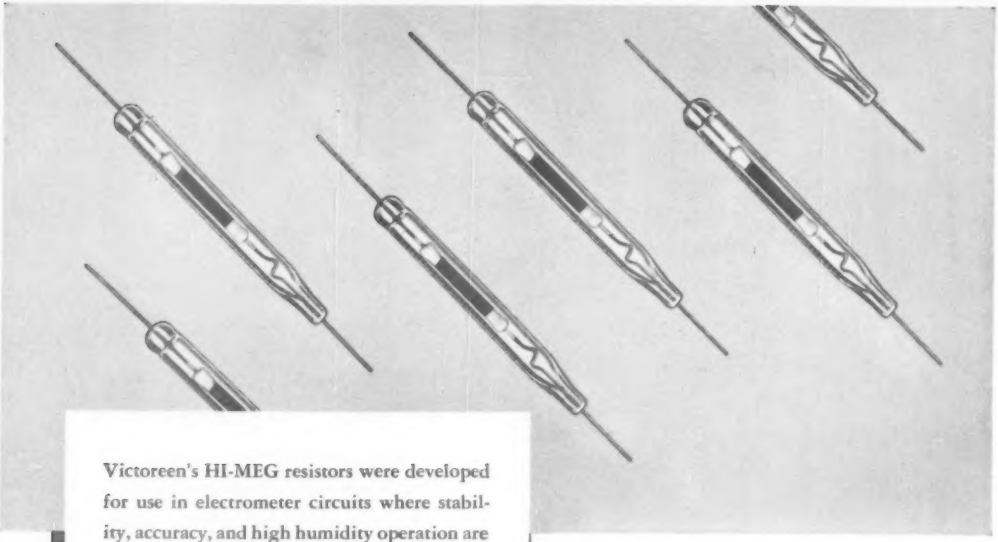


Victoreen's HI-MEG resistors were developed for use in electrometer circuits where stability, accuracy, and high humidity operation are of prime consideration. The resistor element is vacuum sealed in a glass envelope and the glass has been treated with a special silicone varnish to reduce the effects of humidity to a minimum. The resistor is carefully aged to assure stability and reliability.

These precision resistors are often used with Victoreen's electrometer tubes to measure extremely small currents. This combination has found wide application in radiation-detecting instruments, photocell circuits, mass spectrometers, and leak detectors.

Those who use these HI-MEG resistors will concur with us that these are the finest resistors available for large values of resistance.

ANNOUNCING

HI-MEG RESISTORS

...NOW AVAILABLE

IN RTMA VALUES

FROM 10^8 to 10^{12} OHMS

STANDARD VALUES

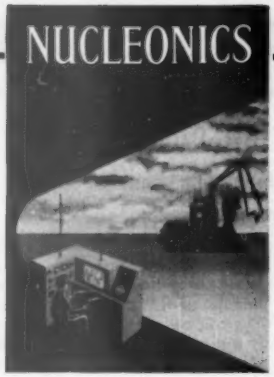
1.0	2.2	4.7
1.2	2.7	5.6
1.5	3.3	6.8
1.8	3.9	8.2

BETTER COMPONENTS MAKE BETTER INSTRUMENTS

COMPONENTS DIVISION

The Victoreen Instrument Co.

3800 PERKINS AVE. • CLEVELAND 14, OHIO



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SCINTILLATION COUNTER

For High Efficiency Alpha, Beta, Gamma, and Thermal Neutron Counting

This universal G-E scintillation counter is used to measure the disintegration rate of any sample which will fit into the two-inch diameter chamber. It detects alpha, beta, gamma, and thermal neutron radiation by the use of interchangeable phosphors. Sample smears from contaminated surfaces can be counted to determine the degree of health hazard. Any standard scaler can be used for counting, provided it supplies positive high voltage and has an input sensitivity of about ¼ volt. Phosphors can be rapidly interchanged. Fits any standard scaler. Large sample chamber. Bulletin GEC-693A.

LOW-BACKGROUND ALPHA COUNTING

- Background: One or two counts per hour
- Plateau length for thin alpha source: 150 v.
- Zinc sulphide phosphor

BETA COUNTING USING ANTHRACENE CRYSTALS

- Background: 30-40 counts per minute
- Plateau: Slope of the order of 1.2

HIGH SENSITIVITY GAMMA COUNTING

- 50,000 counts/min/mr/hr
- Zero background count
- Toluene plus p-diphenyl-benzene liquid phosphor

LOW-BACKGROUND THERMAL NEUTRON COUNTING

- Gamma fluxes up to several R/hr produce negligible counting rates.
- Counting efficiency: 25%
- Plateau: Slope is of the order of 5.

PORTABLE RADIATION PROBE

Interchangeable Caps Provide Selective Detection by Highly Efficient Scintillation Method

A portable model of the scintillation counter described above. Background and plateau length are essentially the same for each respective phosphor. Extremely high thermal neutron counting is made possible by the use of a special G-E phosphor, far superior to enriched boron counters. Thermal neutrons produced by reactors and particle accelerators readily counted. In general health physics work, the thermal neutron detecting unit is especially useful.

Using a ZnS screen for alpha counting, background count is limited to 2 to 5 counts per hour where high-accuracy counting is required. Sodium iodide crystals used in the gamma detecting cap are encased in transparent plastic and mineral oil to eliminate moisture absorption and retain high sensitivity.

A standard connector at the rear of the probe allows connecting cable of any length up to 50 feet. Cable is not supplied with probe but can be obtained at slightly extra cost, if desired. Bulletin GEC-823.

G-E RADIATION LABORATORY EQUIPMENT AND COMPONENTS AVAILABLE

Accelerators, Particle
Alnico Permanent-magnet Materials
Ammeters
Amplifiers
Chambers, Ionization
Controls, Liquid Level
Controls, Millivoltmeter
Controls, Motor
Controls, Pressure
Controls, Remote
Controls, Servo
Controls, Temperature
Counters, Alpha
Counters, Beta
Counters, Gamma
Counters, Neutron
Counters, Proportional
Counters, Radiation
Counters, Scintillation
Counters, X-ray
Crystals, Scintillation
Detectors, Alpha
Detectors, Beta
Detectors, Gamma
Detectors, Leak
Detectors, Neutron
Detectors, X-ray
Furnaces, Electric
Gages, Ionization
Galvanometers
Heaters, Induction H.F.
Instruments, Recording
Insulators, Quartz
Magnetizers
Meters, Survey, Radiation
Meters, X-ray Intensity
Microammeters
Milliammeters
Monitors, Area
Monitors, Personnel
Motor-generators
Motors, Fractional-hp
Oscillographs
Oscilloscopes
Plastics, Protective
Power Supplies, Regulated
Pyrometers
Readers, Pocket-chamber-electrometer
Recorders, Radiation
Relays, Sensitive
Remote Handling Devices
Silicone Grease
Silicone Rubber
Spectrometers, Mass
Thermocouples
Timers
Transformers
Tubes
Ignitron
Mass-spectrometer
Photomultiplier
Rectifying
Thyratron
Voltage-regulating
X-ray
Voltmeters
X-ray Diffraction Apparatus

G-E EQUIPMENT FOR NUCLEAR RESEARCH AND APPLICATION

LONG-PROBE GAMMA SURVEY METER

This scintillation meter is designed for use in areas where high-level monitor and survey work must be carried out. The six-foot probe can help locate the beam of particle accelerators without endangering personnel. It is useful in monitoring areas from behind lead protective shields.

FEATURES

- Lightweight and completely portable
- Long probe affords maximum protection
- Gun-type, sure-grip handle
- Large, easy-to-read indicating meter

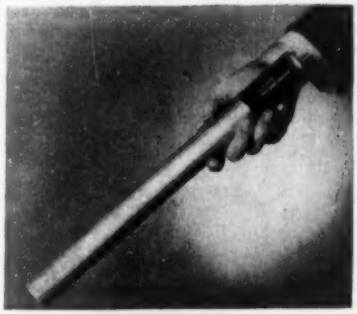
The G-E Long-Probe Gamma Survey Meter consists of a gun-type probe and power supply. The probe is 6 feet long.

The detecting head houses the photomultiplier tube and phosphor. The handle contains the d-c amplifier and indicating microammeter. A range switch provides 5 ranges from 0.3 to 3000 roentgens per hour. Power is supplied from batteries in a lightweight carrying case. A special feature makes it possible to "zero" the instrument in the presence of radiation. Bulletin GEC-732A.

ENRICHED BORON COATED COUNTER TUBE

For High-efficiency Neutron Counting

The G-E boron coated counter tube detects slow neutrons with high efficiency. It is a proportional counter with a thin metallic coating of boron 10 on the inner surface of the cathode. The boron 10 nuclei absorb slow neutrons, then disintegrate into two fragments — one an alpha particle and the other a Lithium 7 nucleus. Both these particles ionize heavily, thus giving an accurate indication of thermal neutron intensity.



FEATURES

• Five times as efficient as natural boron • Free from spurious count • Replaceable gas filling • Bulletin GEC-732.

POCKET-CHAMBER ELECTROMETER

An extremely high-quality, self-balancing electrostatic potentiometer designed for rapid, accurate, and trouble-free reading of pencil-type pocket ionization chambers. Equipped with standard 4-in. meter for direct reading on a 250-milliroentgen logarithmic scale. Sensitive element is a reflecting electrometer in self-contained cartridge unit. Input resistance greater than 10^{17} ohms. Designed for both standard Victoreen and Landsverk pencils. Input power: 105-125 volts, 50/60 cycles, approx 40 watts. Requires no batteries, has an accuracy at 2% of full scale in terms of voltage. Ambient temperature: 0-40 C. Meter indicates rapidly without overshoot.

G-E EQUIPMENT FOR NUCLEAR RESEARCH AND APPLICATION

RADIATION MONITOR Model No. 4SN11A3

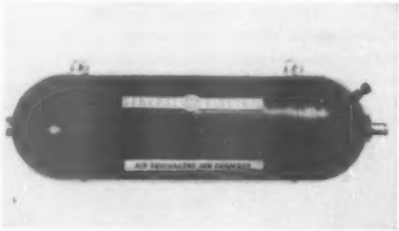
An integrating, self-charging device for measuring milliroentgens of gamma radiation. An easily read pointer-type electrostatic voltmeter, an ion chamber, and an electrostatic generator that requires no batteries, tubes, or external power supply are included in this compact unit. Great simplicity and design safety factors provide a convenient and reliable instrument. Scale range is 20 milliroentgens.

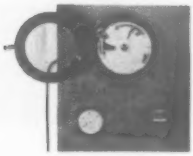
APPLICATION: 1. Monitoring stray radiation to assure safety of personnel in such areas as: (a) Laboratories where radioactive isotopes are handled. (b) Control room and other locations near medical, dental, or industrial x-ray equipment. (c) Areas around particle-accelerator installations. 2. Monitoring in other locations which may be subjected at some time to nuclear radiation. 3. Classroom demonstrations of radioactivity and laboratory experiments with radioactive materials.

AIR-EQUIVALENT IONIZATION CHAMBER

Air-equivalent Type (C): Detects beta, gamma, and x radiation. Can be used as primary detector of radiation. Sensitive to beta, gamma, and x rays with sliding window open, gamma and x rays with window closed. Used for radiation monitoring in atomic-energy plants, health-monitoring in x-ray installations and laboratories where radioactive isotopes are handled. Calibrates radiation instruments; suitable for CD monitoring. The ionization chamber is the primary detecting element for the area health monitor described below. It is available separately for use as a primary detector of beta, gamma, and x radiation.

TYPICAL APPLICATIONS: Radiation monitoring in atomic energy plants • Health monitoring x-ray installations • Civil Defense • Calibration of radiation instruments

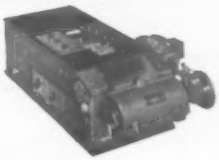




AREA HEALTH MONITOR

Indicates, integrates, totalizes, and telemeters gamma radiation. Provides weekly or monthly integrated record. In addition, an alarm is set off when either average intensity or total radiation exceeds preset tolerance limits. Laboratories, atomic-energy plants, hospitals, and cities can use it for safety and civilian-defense equipment. Typical range is 3 mr/hr to 30 mr/hr full scale. Accuracy ±10% in range of 50 kv to 1.5 mv. Utilizes air-equivalent-type ionization chamber.

OSCILLOGRAPHS



TYPE PM-10

Used in the investigation, design, or testing of various machines and devices. Can record up to 12 variables at once. Simultaneous viewing and recording. Timing lines 1/60 or 1/100 second apart.

TYPE PM-18

Combines versatility and ease of operation with low cost. Produces finished oscillograms in one minute with Polaroid-Land film holder. Can record four quantities simultaneously. Light in weight (30 lb), entirely self-contained.

PHOTOELECTRIC RECORDER

Has high sensitivity and fast response. Uses mirror-type basic element to record rapidly changing phenomena with minimum burden on the measured circuit. Records microamperes, millivolts, and watts directly; also used with accessories to measure temperature, light, speed, vacuum, magnetic flux, and other nonelectrical quantities.

G-E EQUIPMENT FOR NUCLEAR RESEARCH AND APPLICATION

Indicating and Controlling PYROMETERS

THERMOCOUPLES COMPONENTS AND ACCESSORIES

For use with pyrometer equipment. Includes variety of assemblies, thermocouple and extension wires, protecting tubes, wells, ceramic insulators, heads, connector blocks, and thermocouple switches.

Designed for the indication and control of temperature in industrial and atomic-energy processes and for the protection of heat-process equipment. They are ideally suited for use in remote control for the processing of highly radioactive solutions. This is particularly important when these operations must be carried on behind thick radiation shielding. A pyrometer protector, used in addition to controller, protects equipment by shutting down the process at preset temperature above control point in case controller fails.

Close control of process temperature: movement of pointer equivalent to 0.1% full scale initiates instantaneous corrective action. Indicator accurate to ±0.75% full scale. Has high resistance to shock and vibration. Two- or three-position controllers available. Both setpoints for three-position controller independently adjustable. Flush or surface mounting. Automatic cold-junction compensation and thermocouple-break protection standard on all controllers and protectors.

1952 Catalog G-E MEASURING EQUIPMENT FOR LABORATORY AND PRODUCTION TESTING

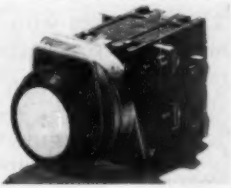
General Electric's testing and measuring equipment intended for use in the laboratory and on the production line. Products range from simple current indicators to the completely automatic oscillographs; from roughness scales to the mass spectrometer. This 80-page catalog is to serve as a reference — to indicate briefly the many devices available for complex measurements. 125 different devices are shown in this catalog. A brief description of each product with its price is included along with its field of application and condensed tables of important characteristics.

New Oiltight
PUSH-BUTTON UNITS

A new push-button unit with building-block construction. It provides flexibility to meet requirements for special units by simple combination of the basic elements, which consist of separable operators, a removable color ring, and a basic contact block.

NEW SEPARABLE OPERATORS:
Operators and contact blocks are furnished separately. Single, double, or tandem contact blocks are quickly and easily attached to any type of operator.

NEW-TYPE CONTACT BLOCK
A single-pole, double-throw contact block. Double-pole, double-throw combinations made by mounting 2 units on the same mounting plate to form a single compact assembly. Or . . . new tandem combination giving 4 normally open and 4 normally closed contacts can be made by combining 4 blocks with a simple adapter plate. New Self-a-line contacts assure true double break. If stationary contacts become misaligned, the movable contact will align with them and will retain that new alignment.

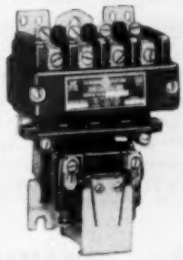


NEW METHOD OF COLOR IDENTIFICATION

The color coding of this new oiltight line is in a removable color ring which screws onto a neutral-colored button. Rings are available in black, red, green, yellow, and white. A push button or selector switch of any color may be converted to any other color merely by interchanging color rings. With a few separate color rings you can save time and money in making up special forms.

20 COMBINATIONS POSSIBLE
With the use of 2 operators, 5 color rings, and 2 contact blocks, 20 combinations can be made to fill the need for special units.

A-C CONTACTORS



25 AMP MAX 60-25 CYCLES

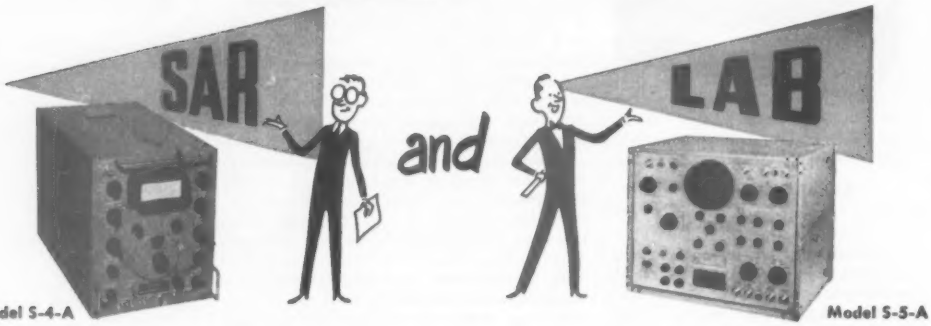
These General Electric CR2810 and CR2811 contactors provide in a small space a simple, sturdy means of controlling power. They may be used to handle almost any type of load.

FEATURES: *Long Life* . . . Exclusive strong-box coil; no metal-to-metal friction; good magnet design; simple moving structure. *Easy Maintenance* . . . Contacts easily removed without disturbing wiring; contact spring cannot be lost; easily disassembled. *Flexible* . . . Tips readily changed from normally open to normally closed without additional parts; double circuit interlocks available; coil easily replaced.

G-E EQUIPMENT FOR NUCLEAR RESEARCH AND APPLICATION

WATERMAN PIONEERING

PULSESCOPE®



Model S-4-A

Model S-5-A

PULSESCOPES are Oscilloscopes to portray the attributes of the pulse: such as shape, amplitude, duration and time displacement. Both of the PULSESCOPES have Video amplifiers with frequency response up to 11 megacycles with Video delay of 0.55 microseconds and pulse rise and fall time better than 0.07 microseconds.

S-4-A SAR PULSESCOPE—Video Sensitivity 0.5vp to p/in. S Sweep 80 cycles to 800KC, either trigger or repetitive. A Sweep 1.2 microseconds to 12,000 microseconds. R Delay 3 microseconds to 10,000 microseconds directly calibrated on precision dial. R Pedestal (or Sweep) 2.4 microseconds to 24 microseconds. Internal Crystal Markers 10 microseconds and 50 microseconds. Size 9⅛ x 11¼ x 17¼". Weight: Less than 32 pounds.

S-5-A LAB PULSESCOPE—Video Sensitivity 0.1vp to p/in. Sweep 1.2 microseconds to 120,000 microseconds with 10 to 1 expansion. Sweep either trigger or repetitive. Internal Markers synchronized with Sweep from 0.2 microseconds to 500 microseconds. Trigger Generator and built-in precision amplitude calibrator. Completely cased. Size: 16½ x 14⅛ x 14½". Weight: Less than 60 pounds.

WATERMAN RAYONIC TUBE DEVELOPMENTS

3 SP

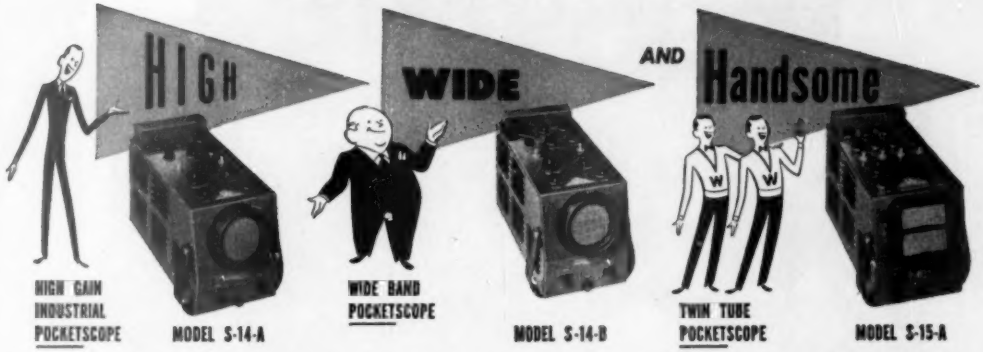
Since the introduction of Waterman RAYONIC 3MP1 tube for miniaturized oscilloscopes, Waterman has developed a rectangular tube for multi-trace oscilloscopy. Identified as the Waterman RAYONIC 3SP, it is available in P1, P2, P7 and P11 screen phosphors. The face of the tube is 1½" x 3" and the over-all length is 9¼". Its unique design permits two 3SP tubes to occupy the same space as a single 3" round tube, a feature which is utilized in the S-15-A TWIN-TUBE POCKETSCOPE. On a standard 19" relay rack, it is possible to mount up to ten 3SP tubes with sufficient clearances for rack requirements. All RAYONIC cathode ray tubes are available in P1, P2, P7 and P11 phosphors. We are authorized to supply 3SP1, 3JP1 and 3JP7 with JAN stamp. All RAYONIC tubes listed below operate on 6.3 volts heater with .6 amp. current.

3 MP

TUBE	PHYSICAL DATA			TYPICAL VOLTAGES				DEFLECTION FACTOR V/IN.		MAX. VOLTS	
	Face	Length	Base	Anode #3	Anode #2	Anode #1	Grid #1	D1 to D2	D3 to D4	Anode #3	Anode #2
3JP	3 inch Round	10 inches	Medium Diheptal 12 Pin	3000	1500	300 to 515	−22.5 to −67.5	127 to 173	94 to 128	4000	2000
				4000	2000	400 to 690	−30 to −90	170 to 230	125 to 170		
3MP	3 inch Round	8 inches	Small Duodecal 12 Pin		1000	200 to 350	0 to −68	140 to 190	130 to 180		2500
					2000	400 to 700	0 to −126	280 to 380	260 to 360		
3SP	1½ x 3 inches	9.12 inches	Small Duodecal 12 Pin		1000	165 to 310	−28.5 to −67.5	73 to 99	52 to 70		2750
					2000	330 to 620	−58 to −135	146 to 198	104 to 140		

THE WATERMAN LINE-UP

POCKETSCOPE®



HI, WIDE and HANDSOME POCKETSCOPES are characterized by small size, light weight, and outstanding electrical performance. All units have frequency compensated attenuators as well as non-frequency discriminating gain controls. All units have both periodic and trigger sweeps from ½ cycle to 50KC. The amplifiers are direct coupled thus frequency response starts from 0 cycles. No peaking coils are used, thus, the transient response is good. Full expansion of trace, both vertical and horizontal, is built in. Means for amplitude calibration are provided. DC coupling in POCKETSCOPES provides unusual stability of the trace, regardless of the line voltage changes or variations of impedances in the input circuit. The HI, WIDE and HANDSOME POCKETSCOPES are the outgrowth of Waterman pioneering of the first commercial miniature oscilloscope, which has proved to be useful and reliable over a period of years. Combination filter and graph screens are used for better visibility, thus traces can be observed even under high ambient light conditions. Binding posts for convenience of connections, with an effective shield, are used. S-14-A has sensitivity of 10 mv/inch with pass band above 200KC. S-14-B has sensitivity of 50 mv/inch with pass band above 1 megacycle. S-15-A is similar to S-14-A except that it has two independent CR Tubes for multi-trace oscilloscope work. Accessories such as carrying cases and probes are available.

S-11-A

The Model S-11-A Industrial & Television POCKETSCOPE is a small, compact, lightweight instrument for observation of repetitive electrical circuit phenomena. The Industrial & Television POCKETSCOPE is a complete cathode ray oscilloscope incorporating the cathode ray tube, vertical, horizontal, and intensity amplifiers, linear time base oscillator, blanking, synchronization means and self-contained power supply. The Industrial & Television POCKETSCOPE can be used, not only for AC measurements, but for DC as well, inasmuch as it has vertical and horizontal amplifiers which are capable of reproducing faithfully within —2 db, from 0 to 200KC. The sensitivity of the vertical and horizontal amplifiers is high and is in the order of 100 mv rms/in.

S-12-B

Model S-12-B RAKSCOPE has the features of S-11-A POCKETSCOPE, plus. The RAKSCOPE is JANized and the government model number is OS-11. The Sweep, from 5 cycles to 50KC is either repetitive or triggered. Vertical and horizontal amplifiers are 50 millivolts rms per inch with band pass from 0 to 200KC. Special calibrating circuitry is provided for frequency comparison. Both the vertical and horizontal amplifiers are identical and use no peaking. The panel is only 7″ high and the scope fits standard rack. The functional layout of the control permits ease of operation.

WATERMAN PRODUCTS CO., INC.

PHILADELPHIA 25, PENNA., U.S.A.

CABLE ADDRESS, POKETSCOPE, PHILA.

WATERMAN PRODUCTS

Manufacturers of POCKETSCOPES® • RAKSCOPES® • PULSESCOPES® and RAYONIC TUBES®

For Reliable Life-Long Performance

RAYCHRONIX MODEL A-4 ELECTRONIC SCALER

Featuring:

- **External Preamplifier**
- **Pulse height selector**
- **Binary scale of 64**
- **Remote control**
- **Hermetically sealed transformers**
- **Terminal board wiring**

It is a well known fact that simplicity, when combined with sound electronic and mechanical design, promotes reliable performance. This is particularly true in laboratory scalers where the Higinbotham circuit has invariably proven at the major laboratories to give more service, less trouble, than more complex scaling circuits.

The Raychronix Model A-4 employs the single binary circuit, to which have been added a number of features for flexible operation. Performance has been proven by mass utilization at one site; maintenance records have enabled continual improvement to the point of exceptional reliability.

For the full story on this quality-constructed, quality-performing scaler why not send today for the 4-page A-4 technical bulletin? If you wish, the Raychronix representative in your vicinity would also be pleased to arrange for a demonstration.

Please send me your A-4 technical bulletin

Name.....

Title.....Dept.....

Company.....

Address.....

City.....Zone.....State.....

RAYCHRONIX

RADIOACTIVE PRODUCTS, INC.

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It's News!

EAI's Dataplotter . . .

An Electronic System That Converts Digital Data To An Analog Plot . . .

Here is a system that will save countless man-hours and costs, and will insure accurate and clear presentation of data.

This new Dataplotter, designed and developed by Electronic Associates Inc., will automatically plot a cartesian curve composed of incremental points or symbols from IBM card data at maximum machine reading speed.

It will accept data from other inputs — Magnetic tape, keyboards, digital computers, etc.

It will retain at all times the basic accuracy of the digital system.

Here's what the Dataplotter system consists of:

Variplotter Model 205G
Digital-to-analog converter, Model 417
Data input keyboard

For further information, clip out and mail the coupon below. No obligation.

ELECTRONIC ASSOCIATES Incorporated

Electronic Associates Inc.
Long Branch
New Jersey

Gentlemen: Would you be kind enough to send me detailed information on your Dataplotter.

Name ..... Title .....
Company .....
Address .....
City ..... Zone ..... State .....

Write

KEPCO VOLTAGE REGULATED POWER SUPPLIES

MODEL 131

B SUPPLY: 100-325 volts, 150 ma.
REGULATION: ½% for both line, 105-125 volts, and load variations, 0-150 ma.
RIPPLE: 10 millivolts.
C SUPPLY: 0-150 volts, 5 ma.
REGULATION: 10 millivolts for line, 105-125 volts, ½% for load at 150 volts.
RIPPLE: 5 millivolts.
FILAMENT SUPPLY: 6.3 volts AC, 10 amp., CT.

MODEL 500-R

OUTPUT DC: 0-500 volts, 300 ma.
REGULATION: ½% for both line, 105-125 volts, and load variations, 0-300 ma.
RIPPLE: 10 millivolts.
OUTPUT AC: 6.3 volts, 10 amp., CT.

MODEL 615

Model 615 is Model 500-R with a C Supply.
C SUPPLY: 0-150 volts, 5 ma.
REGULATION: 10 millivolts for line, 105-125 volts, ½% for load at 150 volts.
RIPPLE: 5 millivolts.

MODEL 141

OUTPUT DC:
100-400 volts, 150 ma.
REGULATION: ½% for both line, 105-125 volts, and lead variations, 0-150 ma.
RIPPLE:
10 millivolts.
OUTPUT AC:
6.3 volts, 10 amp., CT.

MODEL 510

Model 510 features TWO COMPLETELY INDEPENDENT REGULATED POWER SUPPLIES.
OUTPUT DC FOR EACH SUPPLY: 200-500 volts, 200 ma.
REGULATION:
½% for both line, 105-125 volts, and load variations, 0-200 ma.
RIPPLE: 5 millivolts.
OUTPUT AC FOR EACH SUPPLY: 6.3 volts, 6 amp., CT.
The supplies may be connected for series, parallel, or bucking operation.

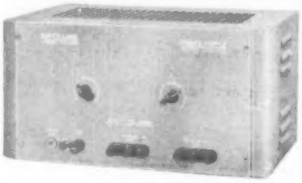
MODEL 245

OUTPUT DC:
200-500 volts, 200 ma.
REGULATION:
½% for both line, 105-125 volts, and load variations, 0-200 ma.
RIPPLE: 10 millivolts.
OUTPUT AC:
6.3 volts, 6 amp., CT.
Available with rack mounting.

MODEL 700

OUTPUT DC:
0-350 volts, 750 ma.
REGULATION:
½% for both line, 105-125 volts, and load variations, 0-750 ma.
RIPPLE: 10 millivolts.
This unit is available delivering:
1.50 amp.—Model 710
2.25 amp.—Model 720
3.00 amp.—Model 730

MODEL 315



B SUPPLY: 0-300 volts, 150 ma.
REGULATION: ½% for both line, 105-125 volts and load variations, 0-150 ma.
RIPPLE: 5 millivolts.
C SUPPLY: 0-150 volts, 5 ma.
REGULATION: 10 millivolts for line, 105-125 volts. ½% for load at 150 volts.
RIPPLE: 5 millivolts.
FILAMENT SUPPLY: 6.3 volts AC, 5 amp., CT.
Available with rack mounting.

MODEL 750

OUTPUT DC:
0-600 volts, 750 ma.
REGULATION:
½% for both line, 105-125 volts, and load variations, 0-750 ma.
RIPPLE: 10 millivolts.
This unit is available delivering:
1.50 amp.—Model 760
2.25 amp.—Model 770
3.00 amp.—Model 780

MODEL 800

Model 800 features TWO INDEPENDENT REGULATED POWER SUPPLIES.

OUTPUT DC FOR EACH SUPPLY: 0-600 volts, 200 ma. In parallel 400 ma.

REGULATION: ½% for both line, 105-125 volts, and load variations.

RIPPLE: 10 millivolts.

OUTPUT AC FOR EACH SUPPLY: 6.3 volts, 10 amp., CT.

MODEL 1250

OUTPUT DC: 200-1000 volts, 500 ma.

REGULATION: ½% for line, 105-125 volts. ½% for load variations, 0-500 ma.

RIPPLE: 20 millivolts.

MODEL 815

B SUPPLY: 0-600 volts, 200 ma.

REGULATION: ½% for both line, 105-125 volts, and load variations, 0-200 ma.

RIPPLE: 5 millivolts.

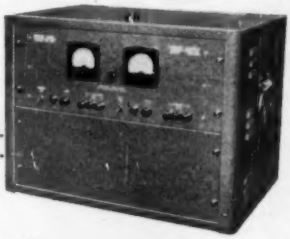
C SUPPLY: 0-150 volts, 5 ma.

REGULATION: 10 millivolts for line, 105-125 volts. ½% for load at 150 volts.

RIPPLE: 5 millivolts.

FILAMENT SUPPLY: 6.3 volts AC, 10 amp., CT.

MODEL 2000



OUTPUT DC: 100-400 volts, 150 ma.

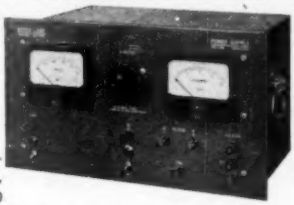
REGULATION: 0.01% for both line, 105-125 volts, and load variations, 0-150 ma.

RIPPLE: 1 millivolt.

OUTPUT AC: 6.3 volts, 10 amp., CT.

The Super Regulator is available for many voltage and current ranges.

MODEL 1020



OUTPUT DC: 0-1000 volts, 50 ma.

REGULATION: 0.1% for both line, 105-125 volts, load variations, 0-50 ma. (range 100-1000 volts). ½% for both line, 105-125 volts, and load variations, 0-50 ma. (range 30-100 volts).

RIPPLE: 10 millivolts.

OUTPUT AC: 6.3 volts, 10 amp., CT.

MODEL 3030

OUTPUT DC: 0-30 volts, 30 amp.

REGULATION: ½% for both line, 105-125 volts, and load variations, 0-30 amp.

RIPPLE: Less than 0.1%.

MODEL 1220

OUTPUT DC: 0-1200 volts, 20 ma.

REGULATION: 0.1% for both line, 105-125 volts, and load variations, 0-20 ma. (range 100-1200 volts). ½% for both line, 105-125 volts, and load variations, 0-20 ma. (range 30-100 volts).

RIPPLE: 10 millivolts.

OUTPUT AC: 6.3 volts, 10 amp., CT.

MODEL 3100

OUTPUT DC: 0-3 volts, 100 ma.

REGULATION: 5 millivolts for both line, 105-125 volts, and load variations, 0-100 ma.

RIPPLE: 1 millivolt.

FOR NEW POWER SUPPLY CATALOG—WRITE DEPT. No. N

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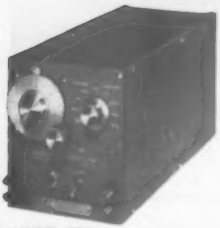
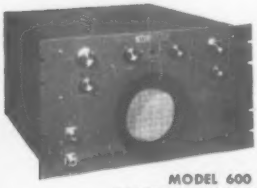


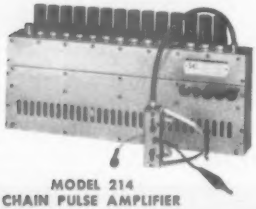
MODEL 300
VARIABLE
ELECTRONIC
FILTER

MODEL 503
FAST-RISE
PULSE GENERATOR

MODEL 202P
WIDE BAND CHAIN AMPLIFIER



MODEL 600
CATHODE RAY INDICATOR



MODEL 214
CHAIN PULSE AMPLIFIER

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New York New Jersey	H. L. Hoffman & Co. 110 E. 23rd Street New York 10, N. Y.
	H. L. Hoffman & Co. 500 Lafayette Building Syracuse, New York
Eastern Pennsylvania	H. L. Hoffman & Co. 1123 Western Savings Fund Bldg. Phil. Pa.
Western Pennsylvania West Virginia	H. E. Ransford Co. Grant Building Pittsburgh 19, Pa.
Delaware Maryland District of Columbia Virginia North Carolina South Carolina Florida	Audio & Video Prod. Corp. 261 Constitution Avenue Washington, D. C.
Georgia Alabama Tennessee Mississippi	Kenneth C. Vance Peacock Building Avenue "A" Opelika, Alabama
Michigan Ohio Eastern Kentucky	J. R. Dennemiller Assocs. 1791 Oakmount Street Cleveland 21, Ohio
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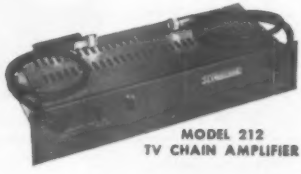
Western Kentucky Indiana Illinois Wisconsin Iowa	Everett Associates 6744 N. California Ave. Chicago 45, Illinois
Missouri Nebraska Kansas	Everett Associates 1629 East 31st Street Kansas City 3, Missouri
Texas Oklahoma Arkansas Louisiana	The Texpart Company 5004 Ross Avenue Dallas 6, Texas
Minnesota North Dakota South Dakota	H. M. Richardson & Co. 9 E. 22nd Street Minneapolis 4, Minnesota
California Nevada Arizona	Harold A. Kittleson 7614 Melrose Avenue Los Angeles 46, Calif.
New Mexico Colorado Utah	Kittleson Company 106-A Cornell Dr., S. E. Albuquerque, New Mex.
Washington Oregon Idaho Montana Wyoming	Hawthorne Electronics 700 S. E. Hawthorne Blvd. Portland, Oregon
or	Cosser (Canada) Ltd. 648A Yonge Street Toronto, Ontario

For further information see your SKL representative, or write directly to SPENCER-KENNEDY LABORATORIES, INC.

MODEL 610
HIGH SPEED SWEEP GENERATOR



MODEL 212
TV CHAIN AMPLIFIER

SKL SPENCER-KENNEDY LABORATORIES, INC.
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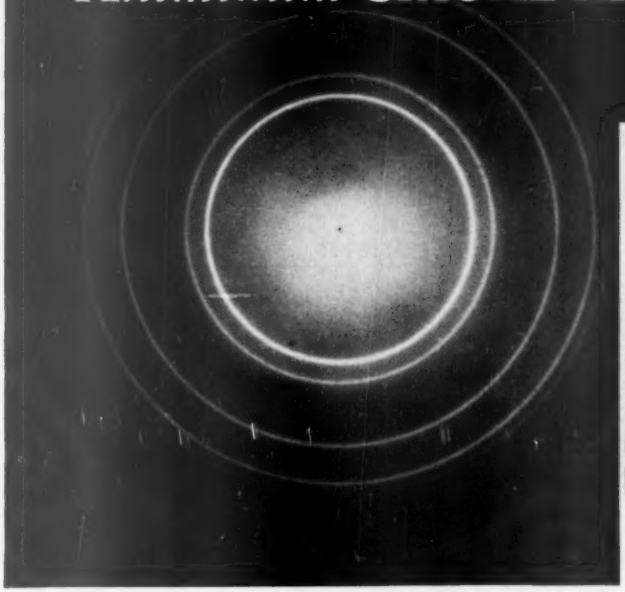
Aluminum SMOKE RINGS.....



Type EMD-2 complete with optical system, power supplies, vacuum system, and control panel. Features include: choice of optics to suit application; 5-control specimen positioning; ports for accessories; built-in charge neutralizer; antihalation beam stop; direct-viewing fluorescent screen; built-in 3-plate camera (4" x 5"); multiple specimen holders; high-speed electromechanical valving.

A diffraction pattern of metallic aluminum by

the RCA Electron Diffraction Unit, Type EMD-2!

THIS pattern reveals fundamental facts about the crystalline structure of an ultra-thin film of aluminum. The pattern was produced in an RCA Electron Diffraction Unit by bombarding the specimen with a beam of electrons—then capturing the diffraction pattern with a camera built right into the unit itself!

This instrument is unsurpassed for producing reflection and transmission diffraction patterns from micro-quantities of materials, surfaces, and monomolecular layers. Type EMD-2 makes it possible to distinguish between structures, or forms of materials, which have the same chemical composition but differ physically. In a matter of seconds it can produce clear, brilliant patterns of matter present in quantities too minute for X-ray diffraction. *It is the only means known for examining the atomic structure of true surfaces.*

Type EMD-2 is effective in work with metals, ceramics, plastics, organic films, biologicals, etc. Its usefulness for investigating corrosion, catalysts, lubricants, surface deposits, graphites, and pigments is well established. For complete data, write Dept. 86-K, RCA Engineering Products, Camden, N. J.

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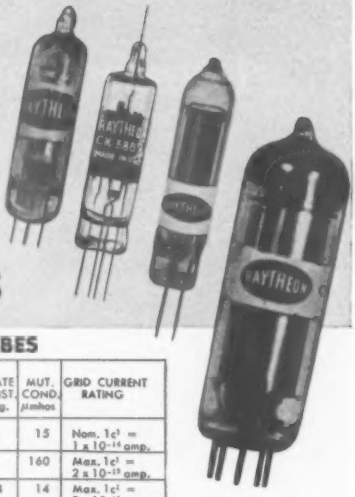
Radiation Measuring Applications



RAYTHEON SUBMINIATURE ELECTROMETER TUBES

TYPE	HTR or FILAMENT			MAX. DIMENSIONS Inches			PLATE VOLTS	GRID 1 VOLTS	GRID 2 VOLTS	PLATE CURR. ma.	GRID 2 CURR. ma.	AMP. FACT.	PLATE RESIST. meg.	MUT. COND. μmhos	GRID CURRENT RATING
	Volts	Ma.	Type	Length	Width	Thick-ness									
CK5884	1.25	10	Fil	1.625	.400	.285	4.5	—3.0		0.02		0.75		15	Nom. $1c^1$ = 1×10^{-14} amp.
CK5886	1.25	10	Fil	1.5	.400	.285	10.5	—3.0	Triode Conn.	0.2		2		160	Max. $1c^1$ = 2×10^{-13} amp.
CK5889	1.25	7.5	Fil	1.6	Diam. — .400		12	—2.0	4.5	0.005	0.005		18	14	Max. $1c^1$ = 3×10^{-15} amp.

RAYTHEON RADIATION COUNTER (GEIGER-MUELLER) TUBES

(All Glass, Self-Quenching)

TYPE	MAX. DIMENSIONS Inches		OPERATING VOLTAGE RANGE Volts dc	PLATEAU LENGTH Volts dc	RELATIVE PLATEAU SLOPE Per 100v	GEIGER THRESHOLD Volts dc max.	BACK-GROUND Unshielded counts/min.	AMBIENT TEMP. RANGE °Cent.	WALL WEIGHT Nominal mg./sq.cm.	EFFICIENCY %	LIFE counts
	Length	Diam.									
CK1890	8¼	$1^{9}/_{16}$	Thres. +50	>150	3%	1100	60	—40 to +50	35	90	10^8
CK1018	8¼	$1^{9}/_{16}$	850-950	>150	3%	850	60	—40 to +55	35	90	10^8
CK1019	8¼	$1^{9}/_{16}$	875-975	>150	3%	880	60	—40 to +55	35	90	10^8
CK1020	6	⅝	850-950	>150	3%	850	60	—40 to +55	35	90	10^8
CK1021	5½	$2^{1}/_{32}$	850-950	>150	3%	850	60	—40 to +55	35	90	10^8
CK1023	5	⅝	850-950	>150	3%	850	60	—40 to +55	35	90	10^8
CK1026	3	⅝	850-950	>150	30%	760	30	—70 to +50	175		10^8
CK1029	5¼	$2^{1}/_{32}$	850-950	>150	3%	850	60	—40 to +55	35	90	10^8
CK1032	3	⅝	1050-1200	>150	30%	1000	30	—70 to +50	175		10^8
CK1034	2⅝	0.400	700		20%	585		—55 to +70	Hvy		$>10^{10}$
CK1035	1.5	.285 x .385	700			585		—55 to +70	Hvy		$>10^{10}$

RAYTHEON SUBMINIATURE RECTIFIER TUBES

TYPE	CONSTRUCTION	FILAMENT		MAX. DIMENSIONS Inches		MAX. PEAK INVERSE VOLTAGE	MAX. PEAK PLATE CURRENT PER PLATE	MAX. DC OUTPUT CURRENT
		Volts	Amps	Height	Diam.			
CK1036	Half Wave — Gas	Cold Cathode		$1^{13}/_{16}$	0.400	1500	10 ma.	100 μa.
CK5785	Half Wave — High Vacuum	1.25	0.015	1.5	0.3 x 0.4	3500	450 μa.	100 μa.

RAYTHEON VOLTAGE REGULATOR — VOLTAGE REFERENCE TUBES

TYPE	MAX. DIMENSIONS Inches		MIN. STARTING VOLTAGE SUPPLY	OPERATING VOLTAGE Approx.	MIN. OPERATING CURRENT ma.	MAX. OPERATING CURRENT ma.	MAX. REGULATION Volts
	Height	Diam.					
OA2	2⅝	⅜	185	150	5	30	6
OB2	2⅛	⅜	133	108	5	30	4
CK1017	$2^{11}/_{16}$	⅜	800	700	0.005	0.055	20
CK1022	$2^{11}/_{16}$	¾	1100	1000	0.005	0.055	20
CK1037	1.75	0.400	730	700	0.005	0.100	15
CK1038	1.75	0.400	930	900	0.005	0.055	15
CK1039	1.75	0.400	1230	1200	0.005	0.100	25
CK5783	1⅛	0.400	115	82-92	1.5	3.5	3
CK5787	$2^{1}/_{16}$	0.400	145	100	5	30	6
CK6213	1⅛	0.400	200	127-133	1	2.5	2

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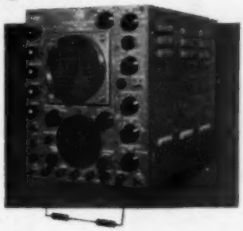


For complete information Ask for Bulletin 052

MODEL 101 MAGNETOMETER

Accurately measures magnetic field strength using the principle of nuclear resonance.

For complete information Ask for Bulletin M52

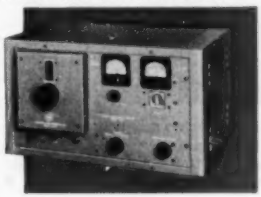
MERCURY DELAY LINES

Used for storage of information, comparison of two sets of information, correlations and sequential timing devices, they are the smallest, most compact lines available.

For complete information Ask for Bulletin MDL51

MODEL 802 STABLE MICROWAVE OSCILLATOR

Provides a highly stable source of microwave signals, suitable for use as a laboratory standard. Features a direct reading frequency dial, sine wave modulation input and self-contained power supply.



Engineering Representatives:

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Gerald B. Miller Company
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Albuquerque 3-1998

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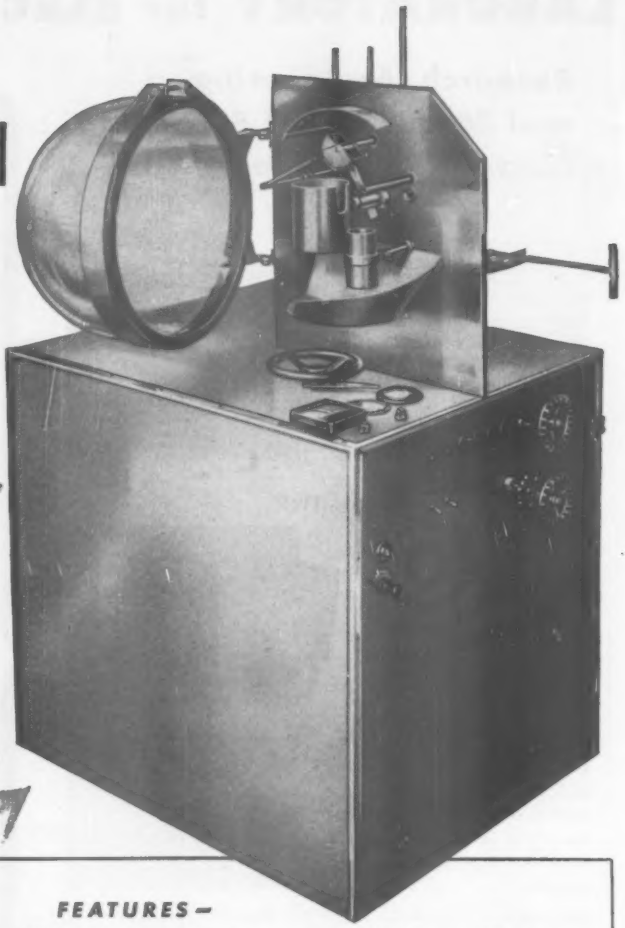
You can afford a High Vacuum Furnace



This ONE
Versatile Unit lets you melt, pour, heat treat, degas

At last there is now available a single furnace that does away with the need to purchase equipment for each phase of your high-vacuum, high-temperature work. Because of its modest price, it will fall within the budget of most laboratories.

With this new furnace you can melt and solidify — melt and pour — add to the melt — stir — look into the hot zone — measure hot zone temperatures — introduce controlled atmospheres — degas — heat treat. It's a complete, versatile unit, capable of handling the widest variety of metallurgical research work. Write today.

FEATURES –

- Ultimate vacuum of less than 5 x 10-5 mm. Hg.
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- Hot zone reaches temperature within one minute.
- No refractories used in hot zone.
- 4" purifying type diffusion pump insures high capacity for out-gassing.
- Utilizes single turn low voltage resistance element of tungsten.
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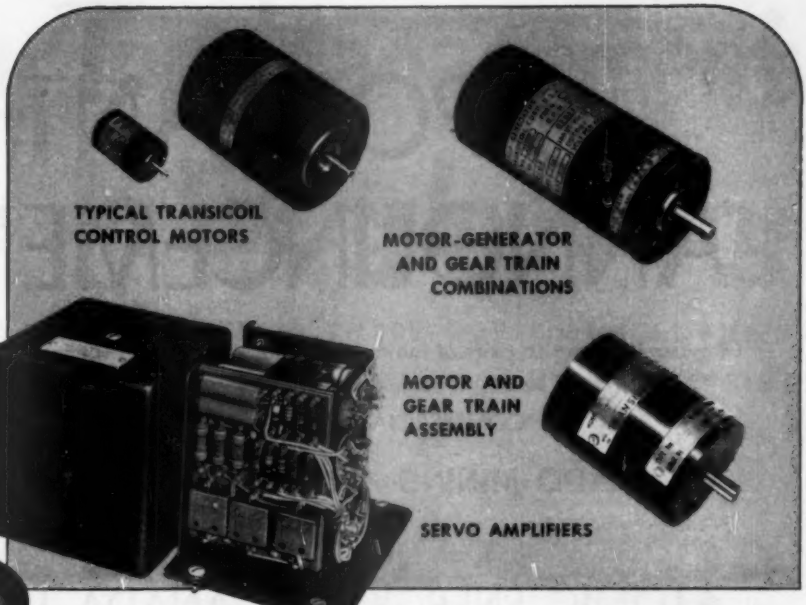
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MOTOR-GENERATOR AND GEAR TRAIN COMBINATIONS
MOTOR AND GEAR TRAIN ASSEMBLY
SERVO AMPLIFIERS

TRANSICOIL ASSEMBLY
with rectangular gear train housing for mounting control motor and data elements.

Dozens of basic Transicoil Servo Motor, Gear Train, and Amplifier types can be readily adapted, electrically and mechanically to fit specific applications *exactly.*

NEW! **12-page catalog with up-to-date specifications on all Transicoil components. Copy gladly sent on letterhead request.**

TRANSICOIL

Precision Components

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IMPORTANT ANNOUNCEMENT

Of general interest to users of radioactive materials is the recent incorporation of the

COMMERCIAL PRODUCTS DIVISION

ELDORADO MINING AND REFINING (1944) LIMITED

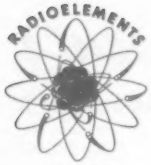
as a division of

ATOMIC ENERGY OF CANADA LIMITED

This transfer is made solely to provide a more comprehensive and efficient service for our customers. No changes in personnel, established agents or business routine are involved.

New applications of radioelements for research, medical and industrial uses, and new mechanical devices, will be announced from time to time.

Your requirements for pile-produced isotopes, radium, accessory equipment or consulting services will be satisfied completely by writing to:



ATOMIC ENERGY OF CANADA LIMITED

COMMERCIAL PRODUCTS DIVISION

P.O. Box 93—Ottawa, Canada

Every Top Management Man... In Every Industry

SHOULD BE ABLE TO ANSWER THESE QUESTIONS ABOUT A MOST CRITICAL EMERGENCY IN OUR COUNTRY'S AFFAIRS

Q. Why is iron and steel *scrap* a matter of importance to me?

A. Steel for our country's military program and civilian economy is being produced at the annual rate of 107,000,000 tons in 1951 . . . 119,500,000 tons expected in 1952. Steel-making capacity is being increased now to meet those quotas.

What Do I Get For My Scrap?

In addition to being paid for your scrap, you remove nuisance inventory from your plant—saving valuable floor space. Also, you have a better chance of *getting* new steel or steel products. But, *most important*—you help alleviate a dangerous condition threatening our country's capacity to rearm and satisfy civilian requirements at the same time.

Q. How does scrap figure in the production of steel?

A. Steel is composed, generally speaking, 50% of pig iron, 25% of "production" scrap (that is, the scrap which is produced as a by-product of steel-making) and 25% of "purchased" scrap.

Q. Is scrap getting scarce?

A. Yes. The supply of *purchased* scrap is not increasing fast enough to meet the needs of increasing steel production.

Q. What if the needed scrap isn't obtained?

A. Open-hearth furnaces will not be able to operate at capacity. That will mean a loss of steel production . . . and fewer products made of steel.

Q. Why not use pig iron instead of scrap?

A. Every ton of scrap conserves approximately 2 tons of iron ore, 1 ton of coal, nearly ½ ton of limestone and many other vital natural resources—to say nothing of the extra transportation facilities that would be otherwise required.

Q. How can *more* scrap be furnished?

A. By everybody pitching in—as we always do in every emergency—and searching out all possible sources of scrap.

Q. What are these sources?

A. Metal-fabricating plants normally turn over to scrap dealers the scrap left from machining. But there's not enough of this to fill our present enormous need. So everybody—both in and out of the metal-fabricating industries—must sell scrap in the form of *idle metal*.

Every pound of idle metal is needed to keep our steel mills operating at top capacity. Sell your idle metal to a local scrap dealer right away.

What Do I Do *First*?

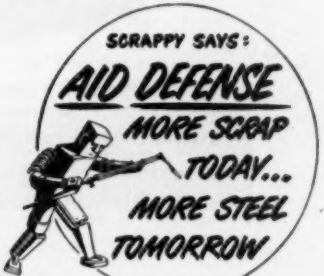
Write for free booklet. It tells how to set up a Scrap Salvage Program in your plant. Thousands of plants are cooperating. Do *your* part now! Address Advertising Council, 25 West 45th Street, New York 19, N. Y.

Q. *We* don't *produce* scrap—how can *we* help?

A. Scrap is any kind of iron and steel that's gathering dust—obsolete machines or structures, jigs and fixtures, pulleys and wheels, chains and track, valves and pipe—*anything* with rust on it or dust on it. Non-ferrous scrap is needed, too.

Q. What do we do with it when we find it?

A. Use your normal channels or get in touch with a recognized scrap dealer.



This advertisement is a contribution, in the national interest, by

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330 WEST 42nd STREET NEW YORK 36, N. Y.

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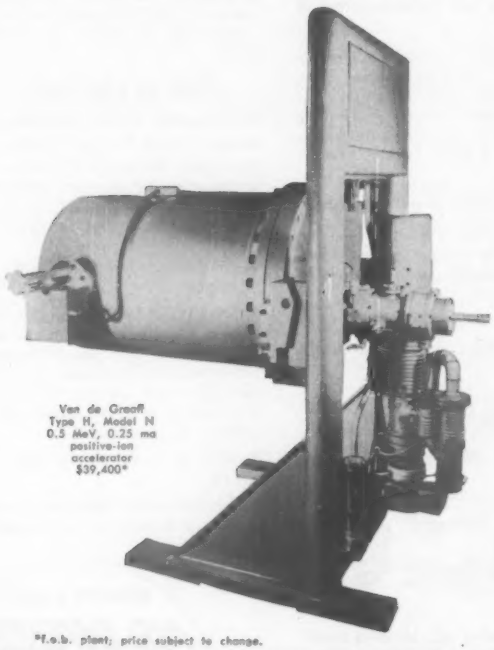
Van de Graaff®

positive ion accelerators as INTENSE NEUTRON SOURCES in

- basic nuclear research
- manufacture of radioisotopes
- activation analysis
- neutron spectroscopy



Van de Graaff
Type H, Model N
0.5 MeV, 0.25 ma
positive-ion
accelerator
$39,400*

*f.o.b. plant; price subject to change.

The neutron output is intense — as high as 10^{11} n/sec. Positive ion energy is 0.1 to 0.5 MeV, or 0.75 to 2.0 MeV. Monoenergetic neutron flux may be obtained, with selection of proper targets — at energies from 30 keV to 8 MeV. Continuous-beam operation is standard — modification to pulsed-beam operation is available on request. Background radiation is low. The target is easily accessible.

And because of the unmatched advantages of Van de Graaff accelerators today — in design, performance, and standardization of manufacture — the cost is within the reach of moderate institutional budgets.

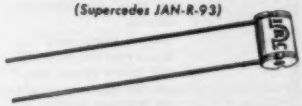
High Voltage Engineering Corporation brings to the field of applied radiation energy a leadership earned over years of experience in the manufacture and application of Van de Graaff equipment. This experience is available to you, to aid in solving your special problems.

HIGH VOLTAGE ENGINEERING CORPORATION

7 UNIVERSITY ROAD CAMBRIDGE 38, MASSACHUSETTS

HERE'S YOUR "AT-A-GLANCE" GUIDE to JAN- and MIL-Type Resistors

Want to know which resistors meet what Armed Forces Specifications? Here's the data you need in handy tabular form. All of these resistors are available on short delivery cycle—from the world's largest maker of resistors.

NAME AND DESCRIPTION	SPECIFICATIONS
TYPE BT ADVANCED FIXED COMPOSITION RESISTORS ½, ½, 1 and 2 watts. IRC filament-type resistance element. Anchored, non-loosening leads. Extra-Bakelite-sealed against moisture or grounding. Low operating temperature. Excellent power dissipation.	JAN-R-11 Specification *(Type BTS meets rigid G Characteristic)*
TYPE BW INSULATED WIRE WOUND RESISTORS ½ and 1 watt inexpensive wire wound resistors for low range requirements. Small and completely insulated. Wire resistance element is uniformly and tightly wound on an insulated core.	JAN-R-184 *(Characteristic B)*
NEW TYPE BOC BORON-CARBON PRECISTOR ½ watt. Latest development in stable film-type resistors. Combines high accuracy and long-time stability. Reduces temperature coefficient of conventional deposited carbon resistors. Replaces high value wire wounds at substantial savings in cost and space. Essential in critical electronic and avionic circuits.	MIL-R-10509A Specification
TYPE DCC DEPOSITED CARBON PRECISTOR ½, 1 and 2 watts. Latest advance in small-size, high stability resistors. Ultimate in non-wire-wound accuracy. Stable over long periods. Assures low voltage coefficient, low capacitive and inductive reactance in high frequency uses. Efficient and economical in modern electrical and electronic circuits.	MIL-R-10509A Specification *plus latest JAN Specification Proposal*
TYPE WW PRECISION WIRE WOUND RESISTORS Severe cycling and 100 hour load tests result in almost no resistance change. New winding forms hold more wire for higher resistance. New winding technique eliminates shorted turns. New type insulation withstands humidity. New terminations are rugged, strain-free.	MIL-R-93A Specification *(Supercedes JAN-R-93)* 
TYPE MF SEALED PRECISION VOLTMETER MULTIPLIERS Completely impervious to humidity. Interconnected precision wound coils are encased in glazed ceramic tube—hermetically sealed. Multiple-layer windings insure resistor against breakdown. Compact, rugged, stable, easy to install.	JAN-R-29 Specification
POWER WIRE WOUND RESISTORS For exacting, heavy-duty applications. Exceptional mechanical strength; withstand severe vibration. Available in two coatings; a variety of ratings, sizes and terminals; fixed and adjustable types; tubular or flat.	 TUBULAR PWW'S —JAN-R-26A *(G and J Characteristics)* FLAT FRW'S— Correspond to JAN-RW Types

SEND FOR FULL TECHNICAL DATA

Complete data on any or all of these IRC resistors are yours for the asking. Use the handy coupon and be sure to ask about IRC's Industrial Service Plan. It enables you to get prompt delivery of experimental or pilot-run quantities—right from the stocks of your local IRC Distributor.

IRC

Wherever the Circuit Says -WW-

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419A North Broad Street, Philadelphia 8, Pa.

Please send me information on the following (checked) IRC resistor types.

Name and address of local IRC Distributor. ( )

*Name*_____

*Title*_____

*Company*_____

*Address*_____ *City*_____ *State*_____

Type BT's ( ) Type BOC's ( ) Type WW's ( )
Type BW's ( ) Type DCC's ( ) Type PWW's ( )
Type MF's ( ) Type FRW's ( )

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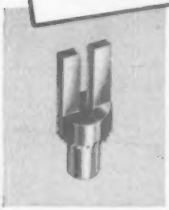
custom or standard the guaranteed components — C.T.C.

SILVER-PLATED BRASS TERMINAL LUGS

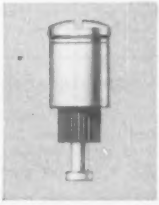
Short Lugs. For low "headroom" applications. Mounted heights from 3/32". In shank lengths for 6 board thicknesses, starting with 1/64".

Turret Lugs. With 2 soldering spaces for 2 or more connections. Sizes range from 1/32" to 1/4" terminal board thicknesses. Mounted heights from 7/32".



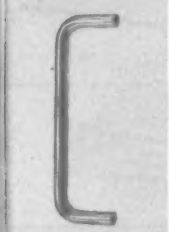
Split Lugs. For potted units where later soldering is advisable. Also standard applications. Hole through shaft allows top or bottom wiring. Fit standard board thicknesses from 1/64" through 1/4". Mounted heights from 5/32".

Double End Lugs. Provide terminal posts on both sides of board. Through connection for easy wiring. For board thicknesses from 1/32" to 1/4". Mounted heights from 5/32".



Combination Lug. Removable screw permits mounting components directly to screw end. Also provides removable link connections at screw end. 3 sizes, 5/16", 11/32", 3/8" diameter. Bright alloy plated for easy soldering.

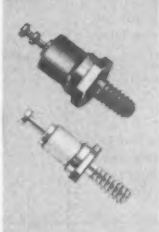
HARDWARE



Handles in nickel-plated brass are available in 3 sizes ranging from 3 5/16" length to 6 3/4" length. Black alumilite aluminum handle available in 4 3/8" length. Ferrules available on brass and aluminum handles.

Other Hardware includes tube clamps, panel and thumb screws, combination screw and solder terminals, shaft locks, terminal board brackets, standoff mounts, etc.

INSULATED TERMINALS



Phenolic. 1/4" diameter, in rivet or screw stud type. Voltage breakdown from 4800 — 11,000 V at 60 cycles RMS.

Ceramic. Silicone impregnated. 5 lengths of dielectric. Voltage breakdown ratings up to 5800 V. Over-all heights range from 3/8", including lug. For high electrical stresses over a broad humidity range. Cadmium plated studs. Brass terminals plated for soldering.

INSULATED FEED THROUGHS

Phenolic. Approved XXX material. Brass bushings, nickel plated. Brass through-terminals, silver plated for easy soldering. Rugged, withstand shock and vibration. Two sizes: for 1/4" and 3/8" mounting holes.

Ceramic. Silicone impregnated. Threaded for 1/4" hole mounting. O.A. length 7/8". Voltage breakdown 4800 RMS at 60 cycles.

TERMINAL BOARDS

Phenolic. Available in various widths and terminal arrangements from 1/2" wide to 3" wide. Thicknesses: 3/32", 1/16", 3/16". All boards in 5 sections scribed for easy separation. Special boards made to your specifications.

Ceramic. Silicone impregnated. Type X1986 with 8 lugs staked in two rows. Standoffs riveted and soldered to ground strap for good grounding at R.F. frequencies. 1 1/16" long, 7/8" wide. All metal parts plated. O.A. mounted height: 35/64".

SLUG TUNED COILS

Phenolic. 3 sizes: 27/32", 1 1/16", and 2" high. 5 standard windings — also special windings or as high-quality phenolic coil forms.

Ceramic. Silicone impregnated. 5 sizes, mounted heights from 19/32" to 1 11/16", diameters from 3/16" to 1/2". Spring lock for slug. Cadmium plated mounting studs. Complete with mounting hardware and high, medium or low frequency slug.

R. F. CHOKES

LHC. High Q iron core with 6-32 mounting stud. 8 values from 2.5 mh to 125.0 mh. Wax impregnated.

LAB. Pie wound on phenolic core with cotter pin terminals. 8 windings .75 mh to 15.0 mh. Current rating 125 ma.

CUSTOM ENGINEERING to your specifications or standard government specifications. C.T.C. Engineers will design all types of Boards, Coils, and Terminal Lugs for production in quantity to fill your needs. *No extra charge for this service.*

WRITE FOR NEW CATALOG. For complete data and engineering drawings on these and other C.T.C. Electrical and Electronic Components and Hardware. No obligation.

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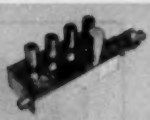
West Coast Stock Maintained by: E. V. Roberts, 5068 West Washington Blvd., Los Angeles 16, California

Atomic's *Research Instrumentation*

LINEAR AMPLIFIERS

Model 204B Linear Amplifier — for use with ionization chambers, scintillation and proportional counters. Rise time to 0.2 microseconds, gain to 15,000. Three-position band width switch. Dual attenuator, precision calibrated pulse amplitude discriminator. Low and high level outputs, self-contained power supply, provision for preamplifier.

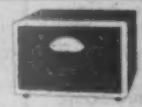
Also Model 204C — similar to 204B with separate input time constant and rise time controls.



LINEAR PREAMPLIFIERS

Model 205B Linear Preamplifier — gain of 20 preamplifier for use with ionization chambers or other low level, high impedance inputs. Obtains power from Model 204 Linear Amplifier and matches low impedance input. Low-noise input circuit permits high voltage operation.

Also Model 206A Impedance Changer — powered from 204, provides high impedance input for proportional and scintillation counting.



REGULATED H.V. SUPPLIES

Model 306 High Voltage Supply — low current stabilized supply for nuclear, biological, etc., research. Regulation under 0.01 percent output change per percent input voltage change. 500 to 3000v continuously variable, to 2000v @ 1 ma., available with positive or negative output.

Also Model 316 — same as Model 306 except with 7"x19" rack mount panel; and Model 326, two units, either polarity, on single 7"x19" rack panel.

COUNTING RATE METERS

Model 410 Counting Rate Meter — for general laboratory use. Four ranges: 0-200-2,000-20,000-200,000 CPM. 2% accuracy. Direct, scintillation and GM probe inputs. High voltage supply, 400 to 2000v @ 1 ma., 0.05 percent regulation. Aural monitor with volume control and output for standard 1 ma. pen recorder. Also Model 409 Laboratory Monitor — a compact bench monitor for routine contamination control, etc.

COINCIDENCE ANALYZERS

Model 502 Four Channel Coincidence Analyzer — resolution of 0.25, 0.5, 1 or 2 microseconds selectable for each channel. Channel deadtime less than 10 microseconds; input pulses positive or negative 2 to 100 volts; output, 25v positive pulses to operate scalers. Individual pulse height discriminators for each channel; one channel may be used for anticoincidence.

Also Model 503C Two Channel Anticoincidence Analyzer — for low level GM tube measurement; with dual regulated H.V. supplies, scale of 16 and register.

PULSE HEIGHT ANALYZERS

Model 510 Single Channel Differential Pulse Height Analyzer — for pulse amplitude distribution studies, with channel base line adjustable to 100 volts and window settable from 0 to 7 volts. Can be used with Model 204 Linear Amplifier and any of Atomic's Scalers to meet many nuclear laboratory needs.

Also Model 520 Twenty Channel Differential Pulse Height Analyzer. The complete answer for a complete analyzer.

PULSE GENERATORS

Model 607 Precision Amplitude Pulse Generator — a high accuracy generator of flat top pulses with no measurable slope or overshoot to 100 volts. Rise and decay time, 1 microsecond or better; high stability, precise calibrated attenuator; 30 to 2700 pps.; 10 to 125 microsecond pulse length; 5 to 120 microsecond pulse delay. Also other pulse and calibration generators, including units for incorporation in multichannel analyzers.

SCINTILLATION HEADS AND CRYSTALS

Model 223 Universal Scintillation Head — for 5819 Photomultiplier Tube and interchangeable crystals and phosphors. For use with: Model 410 Monitor, 1070A Multiscaler, 204 Linear Amplifiers and other of Atomic's equipment. Also hermetically sealed crystals for scintillation counting; standardized Gamma crystals for uniform performance available in several sizes and various configurations.

THE MULTISCALER

Model 1060A — latest version of the first complete automatic scaler. Scale of 1000 or 4096; choice of 5 microsecond or 1 microsecond resolution; preset time; preset count; scale selector; electric register; pulse amplifier (Model 1070A); discriminator; regulated 400 to 2500 volt supply; provision for remote, automatic operation; and many other features. Also many other scaler models.

GLOW TRANSFER COUNTERS

Model 162 Glow Transfer Counter

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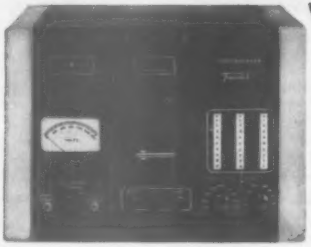

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CHECK WITH *Superior* FOR HEAT AND CORROSION RESISTANT TUBING

Because of Superior's concentration on the production of tubing in all analyses from .010" to 5/8" O.D. we are able to produce as a standard product what many mills are forced to handle as "Specialties". For this reason it may pay you well to check all your heat and corrosion resistant tubing needs with Superior. *Especially if your tubing problem is "different!"* It costs only 3c to be rid of your trouble. Write Superior Tube Company, 2510 Germantown Ave., Norristown, for full information on fine small tubing in any of the following analyses.

STAINLESS STEELS		
A.I.S.I.	303	s
"	304	s-w
"	305	s-w
"	309	w
"	310	s-w
"	316	s-w
"	317	s-w
"	321	s-w
"	347	s-w
"	403	s
"	410	s
"	420	w
"	430	s
"	446	s
"	T-5	s

GLASS SEALING ALLOYS	
27% Chrome Stainless	s
36% Nickel Iron (Invar)	w
42% Nickel Iron	w
52% Nickel Iron	w
42% Ni-6% Cr. Iron (#4 Alloy)	s-w
OFHC Copper	s

NICKEL AND NICKEL ALLOYS	
"A" Nickel[1]	s-w
"D" Nickel[1] (4½% Mn Nickel)	s
"L" Nickel[1]	s-w
Monel[1]	s-w
"K"-Monel[1]	s
Inconel[1]	s
Inconel X[1]	s
Nichrome V[2]	s-w
30% Cupro Nickel	s

SPECIAL PURPOSE ALLOYS	
Advance Alloy[2] (Constantan)	w
Beryllium Copper	s-w
Globeiron	s
Armco Iron	w
Deoxidized Copper	s
Commercially Pure Titanium	w
Hastelloy Nickel—Base Alloy B[3]	w
Hastelloy Nickel—Base Alloy C[3]	w

Also Carbon Steels and Alloy Steels.

s—Seamless
w—Weldrawn

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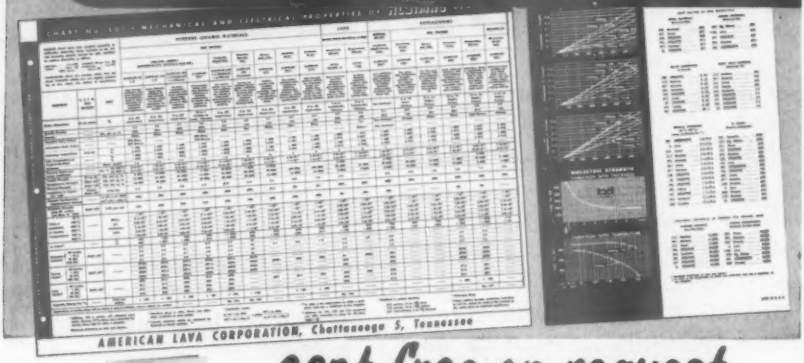
Superior

THE BIG NAME IN SMALL TUBING

All analyses .010" to 5/8" O.D.
Certain analyses (.035" max. wall) up to 1 3/8" O.D.

SUPERIOR TUBE COMPANY, 2510 Germantown Avenue
Norristown, Pennsylvania

New Property Chart of ALSIMAG
TECHNICAL CERAMIC COMPOSITIONS



sent free on request

American Lava Corporation, Chattanooga 5, Tennessee, has issued a new chart giving the mechanical and electrical properties of AlSiMag custom-made technical ceramics.

WHAT ALSIMAG IS

AlSiMag is the trade name of a large family of technical ceramic compositions. These compositions have different physical, electrical, mechanical and chemical characteristics. AlSiMag ceramics are custom-made to specifications.

WHAT THE CHART TELLS

The chart covers seventeen of the more frequently used AlSiMag compositions and is the most complete chart yet issued in this field. A new feature is a selection chart which simplifies and speeds the selection of the most useful composition for the individual requirement. This selection chart indicates lower cost materials in BOLD FACE. This helps the product engineer to design for utmost economy.

Some properties, such as thermal expansion, dielectric strength, in relation to thickness and temperature are presented in graphic form.

ALSIMAG COMPOSITIONS NOT ON CHART

Many special AlSiMag compositions have been developed to meet specific conditions. These are too numerous to chart. If chart indicates general characteristics of value, modifications to suit your special application may be available.

WHO NEEDS THE CHART

Designing engineers, production technicians or purchasing agents will find chart helpful in their search for materials for unusual applications.

HOW TO GET THE CHART

The AlSiMag Property Chart is sent free on request. Request as many copies as you need to cover your organization.

51ST YEAR OF CERAMIC LEADERSHIP

AMERICAN LAVA CORPORATION

CHATTANOOGA 5, TENNESSEE

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come to **Helipot**
for the largest selection of **multi-turn** *precision potentiometers*

From the world's largest manufacturer of precision potentiometers

advanced engineering! volume production!

HELIPOT is the organization that originated the helical potentiometer—the device that brought to electronic engineering new horizons of precise control by its greater resolution, higher linearity, mechanical precision, and greater range of resistance values. HELIPOT's policy of constantly working to anticipate the needs of the industry has led to steady advancement in the basic multi-turn principle—and today, HELIPOTS are available in the industry's widest selection of ranges and designs to meet varying requirements.

HELIPOT offers you . . .

▶ **Advanced Engineering.** Through 8½ years of leadership HELIPOT has built an organization unequalled in the industry—with trained engineers, specially-designed equipment, overall facilities to solve *tough* potentiometer problems.

▶ **Volume Production of Special Designs.** HELIPOT not only welcomes tough potentiometer problems, but also has expanded facilities to mass-produce special designs to rigid specifications—at economical cost!

▶ **Versatile Basic Designs.** Most of the basic units shown below can be readily adapted to special requirements—ganged assemblies, servo mountings, single or double shaft extensions, taps spot-welded to a *single* turn of winding at virtually any desired point, and many other individualized features to meet *your particular needs!*

Illustrated below are typical basic models of Multi-Turn Helipots . . .

MODEL A:
A 10-turn unit, approximately 1¾" diameter with 12 to 14 times the resolution of single-turn units of same diameter. Very versatile—low in price—wide range of applications.*

MODEL C:
Similar to Model A, but 3 turns of resistance winding instead of 10.*

MODELS B, D, & E:
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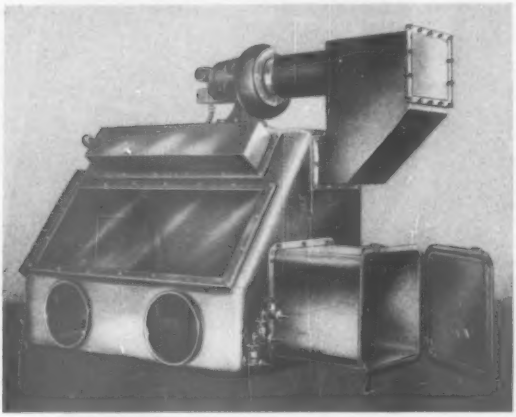

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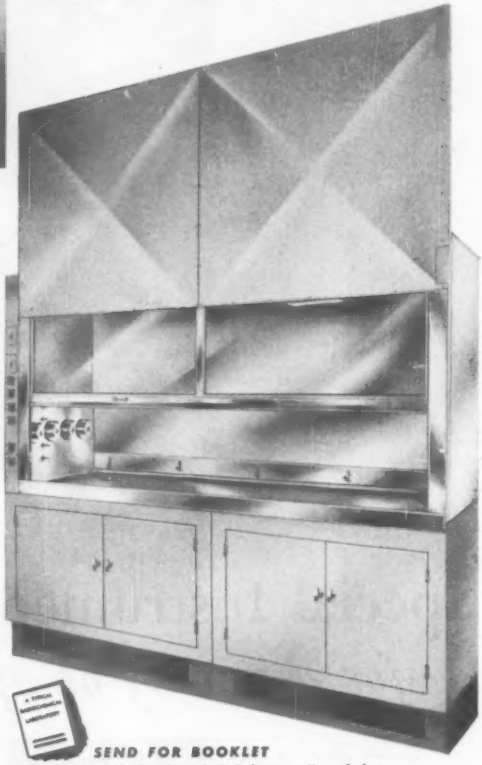

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NUCLEONICS

NOVEMBER, 1952

WANTED:

Smaller and More Reactors

OF THE MANY PROBLEMS which make the establishment of a bona fide nuclear energy industry difficult, I think the most serious stem from our "nuclear megalomania." We have been conditioned to think of nuclear installations as multi-hundred million dollar enterprises. In seeking a way to bring nuclear reactors into the usual channels of competitive industry, we have therefore naturally turned—as in Mr. C. A. Thomas's well known proposal—to combination plutonium plus power systems. To produce plutonium economically and at the same time make power at five mills/kwh or so, these systems must necessarily be enormous.

For the present the number of 150 million dollar reactors which even our country can afford is small. As a result, our nuclear energy technology consists mainly of a very few very large projects. Because the technology depends on so few separate entities, it is hard to inject into it the kind of developmental flexibility which characterizes, say, the automobile industry. Risks are hard to take, and the demand for AEC subsidy of the risk is perfectly understandable, especially since AEC is the only customer. As long as there is only one customer who also pays all the development bill, it is idle to try to impress the cast of traditional private industry on nuclear technology.

In every other major technology—airplanes, power, hydraulics, bridge-building, architecture, even rockets—the art has developed from small, simple, and relatively cheap devices to large, complicated, and expensive ones. These industries, in contrast to nuclear technology, have therefore been able to depend on a whole size spectrum of gadgets. This size versatility has given flexibility to these developments; it has made it possible for each technology to generate a comparatively broad consumer demand for its many different products.

To some extent, the reactors for military propulsion—the STR, SIR, and aircraft—will help to reduce the scale of each step in our nuclear development. In this respect the military reactors ought to inject more flexibility into nuclear development than it now possesses. However, the military reactors, as articles of commerce, suffer from the usual difficulty that in a military framework economic considerations tend to be abrogated. Military reactors, as other military devices, always must pay a price for the time that they buy.

THERE IS ANOTHER AREA of nuclear reactor development, however, which could rather soon be put on an economic basis, and which I regard as an attractive alternate to the colossal

plutonium-plus-power schemes as a way for industry to get a start in nuclear energy. I refer to Mr. L. R. Hafstad's recently reiterated suggestion of small, cheap nuclear power packages for use in remote localities where power is now very expensive.

There must be a substantial number of places within U. S. jurisdiction which could use blocks of power of a few thousand kilowatts at a price of 3, 4, or perhaps, in some cases, 5 cents per kwh. I believe it ought to be possible to take the experience gained from the ship reactor projects, and by rationalizing designs, to come up with a relatively cheap nuclear power package in the 5,000 kw (of electricity) class, with installation costs of the order of $500 per kw, and power costs between 2½ and 4 cents per kilowatt hour. If there were even fifty locations where such power packages could be used economically, supplying these devices might develop into a spirited, flexible $150-million business which would not be dominated by any single government agency.

THE MAJOR PROBLEM in any such scheme is of course the allocation of fissionable material. However, as Mr. Gordon Dean indicated in his recent San Francisco speech, we will in the foreseeable future be entering a period where the demand on fissionable material for bombs *ought to* be more than met, and there will be extra U^{235} or Pu^{239} left over for power purposes. I would imagine that many of the customers for such out-of-the-way power plants might be government or quasi-governmental agencies whose requirements for power, and therefore U^{235}, might be justified—as is the Navy's—by the needs of national defense.

The design of such a power package would have to depend strongly on experience with, say, the STR. Some regeneration of fuel would certainly be desirable. As Mr. Zinn said in the September '52 NUCLEONICS, the fuel cost would be 1.3 mills per kwh if a conversion ratio of as little as 0.8 could be achieved. However, the figure of between 2½ and 4 cents per kwh ought to be achievable even without fuel regeneration.

THE MAIN ADVANTAGE of the power-package approach to establishment of a nuclear energy industry is that the technology would rely on comparatively many small units, rather than on a very few enormous ones. Thus industry would not try to hit the jackpot right off, but would edge into the business a little at a time and at each stage would be able to match its risk with its financial capability.

It seems to me that NUCLEONICS could do the infant nuclear energy industry a very real service if it carried out a survey to determine just how big the market is for, say 3 cents per kwh electricity. There are perhaps a dozen working groups throughout the country who, once they were convinced of the existence of a market for nuclear power packages, might set to work trying to design the best such package. I hope that out of such competitive effort, centering on these small power packages, might come the beginning of a real, vigorous nuclear power industry.

ALVIN M. WEINBERG, *Director of Research*
Oak Ridge National Laboratory

[*Dr. Weinberg's comments on the development of small power reactors suggest very interesting possibilities for the embryo nuclear power industry. Because the degree of interest in such reactors depends on the market,* NUCLEONICS *accepts Dr. Weinberg's challenge and is arranging for the McGraw-Hill Department of Economics to analyze the domestic and foreign market. The results of this survey will be published in* NUCLEONICS.—THE EDITORS]

Remote Control Engineering

1947

1948

1949

1950

195X

EVOLUTION of manipulators is traced by these photos of ANL units, with the future depicted by a robot (see below)

PHILOSOPHY AND PRACTICAL EXPERIENCE OF ARGONNE NATIONAL LABORATORY

A NUCLEONICS SPECIAL REPORT

THE HANDLING of radioactive materials at intermediate and high levels (up to 10,000 curies) of activity invariably requires remote control apparatus. It is evident, then, that the problem of remote control has had to be faced at almost all AEC installations. Each one faces its own special and specific handling problems; each has developed specialized apparatus to perform certain required functions.

This approach is not a complete solution to the over-all problem of remote control manipulation. It does not necessarily cover the broad or general approach.

In 1947, Dr. W. H. Zinn, director of Argonne National Laboratory, recognized the need for a new comprehensive approach and established a special group that became known as the Remote Control Engineering Division under the direction of Dr. H. L. Hull. Argonne was being established as one of AEC's major research centers where a well-rounded fundamental research program in the basic sciences and research and development on reactors would be carried out. The usefulness of its $60-million facilities, the versatility and speed-with-safety with which research could be conducted, depended upon development of the best possible remote control equipment.

During the past five years, the Remote Control Engineering Division has been responsible for the development of general handling devices and associated viewing equipment that are being used at Argonne and at many other AEC and non-Commission installations. A broad philosophy of remote control manipulation and viewing served as the basis for this work. This philosophy, its results, and future possibilities are described here by members of the division.

The Cover. The robot shown on the front cover is a representation of a device that may one day take its place in the complement of equipment specially designed to handle hazardous objects. Such a robot is proposed in this report by the Argonne group; the cover is a NUCLEONICS staff artist's conception of the proposed ANL robot. This design includes radio-controlled manipulating arms and binocular television viewing mounted on a mobile, self-propelled vehicle.

Remote Control Engineering

AN INTRODUCTION

By **H. L. Hull**

Director, Remote Control Engineering Division

UNMODIFIED testing instruments can be operated by master-slave manipulators, saving expense of modifications

DURING the early post-war expansion of AEC, the problem of handling radioactive materials at much higher levels of activity than those previously used in research arose. New reactors were planned for the future, requiring a broad research and development program.

New fuel elements and structural materials would be required. It would be necessary to measure the physical, metallurgical and chemical properties of new materials before and after neutron irradiation under conditions similar to those to be encountered under actual operation of the proposed reactors. The measurement of such physical properties as hardness, tensile strength, specific gravity and electrical conductivity required working with gamma activities of thousands of curies.

Wartime facilities for such research were limited and inadequate for the accelerated post-war program. These facilities had of necessity been hastily constructed. The techniques and equipment used were satisfactory for certain purposes involving repetitive or simple operations. Simple manipulators, which were quite limited in function and performance, were employed. These often were extensions of simple tongs. Viewing around simple shielding arrangements was generally accomplished by mirrors or, in the case of enclosed cells, by monocular periscopes. When available remote control devices did not suffice, special-purpose remote control equipment designed to perform a specific task was built, sometimes at considerable cost. Standard laboratory instruments and apparatus were modified for remote control at costs sometimes running to many times that of the original equipment. This procedure left much to be desired.

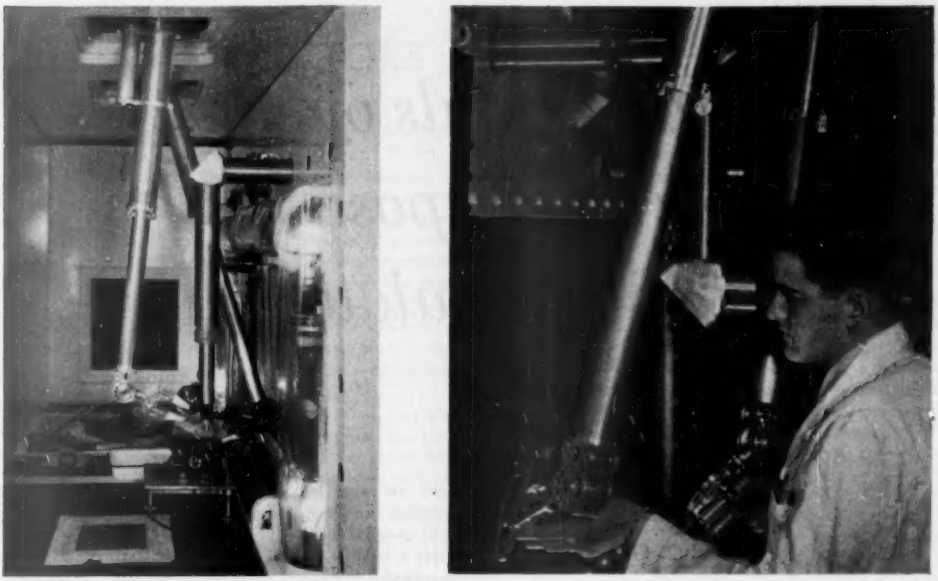
New approach. Analysis of the problem indicated that too much emphasis had been placed on the equipment at a remote point, and that insufficient attention had been paid to the operator. A much better approach, at least for research work by remote control, it seemed, was to start with the operator, considering him to be the most important part of the over-all system, and to extend his skills so that he could perform work from which he was physically separated.

The new approach was to provide the scientist with easily controllable mechanical arms and extend his binocular vision so he could operate existing standard laboratory equipment behind shielding barriers with minimum modification and at the same time be prepared for unpredictable requirements and emergencies.

This is the general-purpose manipulator approach which has been developed at Argonne and which has contributed much to the speed, safety and economy of research in hot laboratories. To build equipment to enable the operator to barely perform a task is not sufficient. It is necessary to build manipulators, viewing systems and auxiliary equipment which the operator can use easily and effectively.

In the Argonne system, the eyes of the operator are effectively extended with direct binocular vision by large nondarkening shielding windows. The arms of the worker are extended by highly dexterous and force-reflecting "master-slave" manipulators. The operator is an integral part of the system and works in a natural manner. He works automatically without having to give special thought to each succeeding move. This system provides manipulation which was impossible with periscopes or mirrors and limited-purpose manipulators.

Safety. The volume of work with radioactive materials has increased greatly in recent years and has in



MICROSCOPIC examination is done remotely with aid of manipulator, window for general operative viewing, and periscope for detailed observation

general been at much higher activity levels. Where a few curies were previously considered high, research at Argonne on samples with activities as high as 10,000 curies of gamma radiation can be routinely performed.

It is believed that the use of the new hot laboratories at Argonne with shielding windows and master-slave manipulators has contributed much to the safety of research work. This may be due, in part, to the fact that there is less temptation to bypass or go around the protective shielding barriers.

Economics. Work on radioactive materials is expensive. The cost of facilities is of necessity quite high. As an example, consider just the cost of nondarkening glass. During 1948–1949, when the glass was being developed, the volume of business was around $10,000. In 1950–51, the demand ran to about $100,000, and during 1952–53, the requirements for this one new product alone will run to about $1-million.

It is believed, however, that the over-all cost of research has been minimized by savings due to greatly increased speed of operation. Research is carried out many times faster in the present Argonne facilities than is possible in older type facilities. Research workers have been able to make physical-property measurements on fuel elements and structural materials for reactors which have materially advanced the time scale of the reactor program. It is believed that substantial savings have also been made by being able to use standard equipment such as hardness testers, chemical balances, micrometer calipers, etc., with little or no modification.

Long-range program—Robots. Looking to the future, the possibility of extending the usefulness of the present master-slave manipulators has been investigated. Fundamental work has been done on force-reflecting (feel) servos which would replace the present direct mechanical linkages. This would give greater flexibility in "local" operations and at the same time prepare the way for fully remote operations (robot) with master-slave dexterity and feel.

To provide eyes for the robot of the future, stereo-television has been investigated. This was demonstrated in 1950 in conjunction with existing master-slave manipulators and switch-operated electrical manipulators. Although further development work was indicated and is being carried on, there is little doubt as to the feasibility and possibilities of a robot with electronically-controlled slave hands and binocular vision by three-dimensional television.

Auxiliary and specialized equipment. The need for elaborate modification of standard equipment has been reduced, but there has been the call for developing equipment ranging from syringe controls, pipettes, motorized ring stands, dry atmosphere boxes, hose pumps, special hoods, etc. for radiochemistry laboratories, to special equipment for decanning irradiated fuel elements.

Our division also develops special reactor fuel-handling equipment, and reactor control systems. Irradiation chambers have been developed which use Co^{60} as a source of gamma rays for fundamental studies. A report on "The Radiobiology Gamma-Neutron Chamber" will soon appear in NUCLEONICS.

The accompanying articles by R. C. Goertz, F. Bevilacqua, K. R. Ferguson, and G. S. Monk describe in considerable detail the cooperative efforts of the members of this division on manipulators, windows, and the pioneering work on noncoloring or nondarkening glass for optical instruments and windows.

Fundamentals of General-Purpose Remote Manipulators

By **Raymond C. Goertz**

Associate Director, Remote Control Engineering Division

MANY OF THE PROCESSES involving handling radioactive materials can be carried out by special remote control equipment designed for specific functions. But in laboratory work, where a large variety of tests must be carried out and where complicated apparatus must be manipulated, it is costly and time consuming to develop and build remote control equipment for each and every test. Consequently, there is a strong need for a manipulative device to do essentially the same kind of work that is normally done directly by hand.

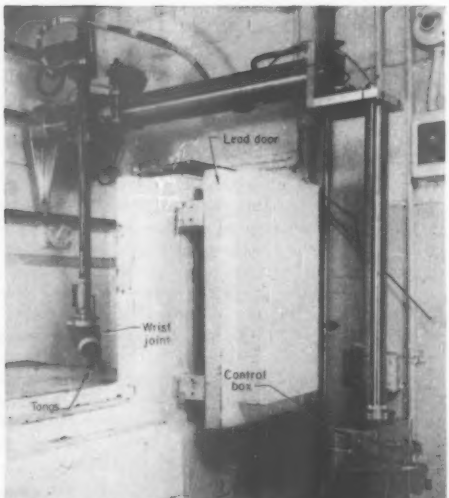


FIG. 1. Rectilinear manipulator, 1947 model, has hydraulically-operated tongs. Operator controls motion with on-off switches

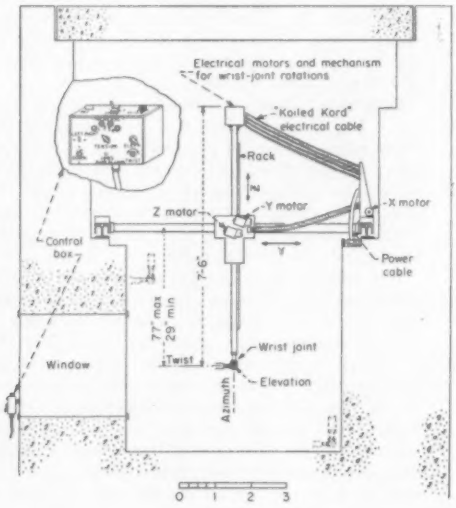


FIG. 2. Four different gripping forces can be used with this all-electric manipulator. Switches control operation of this manipulator too, and operator cannot "feel" what he is doing

EARLY MANIPULATORS . . .

Manipulators capable of performing diverse functions have been developed in many different forms. Figure 1 shows a 1947 model rectilinear manipulator installed in an open-top shielded enclosure (sometimes called a cave or cell). This manipulator has three degrees of freedom in translation and three degrees of freedom in rotation at the wrist joint and an independent motion for opening and closing its tongs. Six of these motions are controlled by operating an individual on-off-on switch for each motion. The tongs are operated by an hydraulic system which reflects the tong squeeze force back to the control handle. These switches and the tong control are mounted in the control panel.

A similar manipulator, improved somewhat over the one shown in Fig. 1, is illustrated in Fig. 2. This manipulator is controlled in the same manner as the first one except that the tongs are opened and closed with an electric motor instead of by an hydraulic system. The gripping force in this case is not reflected back to the operator, but he has a choice of selecting four different maximum gripping forces.

. . . THEIR SHORTCOMINGS

These manipulators lack several features that are needed in many types of manipulations and are slow and somewhat awkward to operate. They have neither force indication nor force reflection (feel); therefore extreme care must be exercised when they are used in connection with or in the vicinity of delicate apparatus. Operators of these manipulators require considerable training but never can achieve the control and dexterity needed to perform the more complicated manipulations.

STUDY OF REQUIREMENTS

To fill the need for general-purpose manipulators capable of performing a wider variety of manipulations with greater speed, accuracy and dexterity, a study was undertaken to determine the optimum characteristics such a manipulative system should have. This study approached the problem from two different points of view in order to establish the minimum requirements that would yield good performance.

The first approach includes the cybernetics* of normal manual manipulation, since every motion of the manipulator is controlled by a human operator. The high number of degrees of freedom and the multitude of stimuli and responses that exist in a human arm and hand immediately suggest that it is impossible and impractical to duplicate all of these features. Therefore, the other approach to the problem was to establish the kinds of manipulations that the manipulator should perform and to derive the minimum features that must be incorporated into the manipulative system to carry out these functions. These two approaches must be blended together to give a unified manipulator system having high performance capabilities.

The study and research on general-purpose manipulator systems has many goals, as well as many problems. The first goal is to develop and build general-purpose remote manipulators and associated equipment which will approach the dexterity of manual manipulation. Little training or mental effort should be required to control these manipulators, for most of the operator's mental capacity and attention should be devoted to the effects or results of the manipulation. There is no hope of achieving the complete dexterity of man in a remote manipulative system; however, the most important characteristics can be achieved.

A second goal is to expand the capabilities of this type of remote manipulative system by designing it for higher load capacities and greater movements than those of the unaided human arm.

A third goal is to increase some phases of the dexterity of the manipulative system actually beyond that of the unaided hand by giving it higher sensitivity of feel and greater positional control.

A fourth goal might be considered the assembly of these dexterous manipulative arms on suitable remote control mobile vehicles with suitable viewing. These devices might be called general-purpose robots.

Of course, research and development is required on many components or links of the over-all manipulative system to reach these goals. Some important components are improved remote viewing systems, bilateral servomechanisms, and complicated mechanisms for use in the manipulator arm and control system.

Typical questions that arise from such a study are: What kind of tongs or fingers should the manipulator have to grasp diverse objects? What general shape should the mechanical arm assume and how many degrees of freedom are required? What kind of drive systems are suitable and how much effective inertia and friction is permitted? What shape and arrangement should the control handle or handles assume and in what manner should they control the mechanical arm? Over what distance can normal viewing be used?

Answers to many of these questions have been found, but some require further research and study.

* Cybernetics is the science of communication and control in the animal and the machine.

FUNDAMENTALS OF MANUAL MANIPULATION

Before the important features to be included in the design of a remotely controlled general-purpose manipulating system are set down, a brief and elementary description of manual manipulation will be useful. The laws governing the human control system, including cause and effect or stimulus and response, are not well understood, but the superficial reactions at least are worthy of consideration.

In normal manual manipulations the person visually observes a particular situation. If a change is desired, he mentally plans which objects are to be moved and the approximate path they should follow. No sooner has this decision been made, than his brain sends out internal stimuli which cause muscle responses to move the hand and arm toward the object. As this motion is taking place, kinesthetic signals are received at the brain which indicate the position, velocity and force of the arm and hand, as well as a multitude of other information. When the fingers come into contact with the object, tactual stimuli are also transmitted to the brain. Normally the hand will come to rest when it comes into contact with the object unless the object is very light. This part of the operation is simply getting the arm to the desired location.

The fingers are then closed on the object. If it is desired to move the object in a given direction, additional internal stimuli from the brain cause the muscles to contract in such a way as to give a resultant force and/or couple in the direction in which motion is desired. As the forces or couples are applied, kinesthetic feedback signals keep the brain informed as to their magnitude and direction, as well as the motions and new positions of the object.

The human arm itself is a motor (muscle)-driven mechanical device which receives its intelligence and direction from the brain. Kinesthetic feedback signals of position, velocity, force, tactual sensation, etc., are continuously sent back to the brain from the arm muscles and other components. The arm thus acts as a servomechanism receiving its input direction from the brain. The brain receives additional information about the object and associated equipment by other stimuli such as vision and auditory feedback data.

TYPES OF MANIPULATIONS

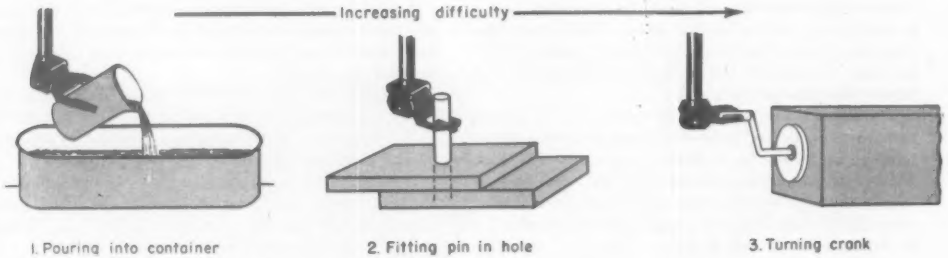


FIG. 3. Three types of manipulations of increasing complexity

To bring out specific features that are needed in a manipulator arm (mechanical or human), three general types of manipulations having increasing complexity will be investigated. These are illustrated in Fig. 3.

The first type is the handling of diverse solid objects by picking them up with tongs, orienting and placing them in a different location. An example is picking up a container and tipping it to pour out liquid or solid specimens.

In no case is the manipulator or object brought into intimate contact with "grounded" (fixed) surfaces or apparatus. Manipulators of the types illustrated in Figs. 1 and 2 have all of the necessary features, except the speed, safety, and ease of operation required for this kind of handling.

The second general type of manipulation involves the handling of solid objects and bringing them into intimate contact with grounded equipment. Examples are inserting a relatively snug-fitting pin into a hole such as that in a chuck, or fitting a part into place on its mating assembly.

When an object, grasped by the manipulator or human hand, is fitted to its mating part, its final orientation and position is dictated by the fixed part. Compliance is needed to allow this accommodation. Without compliance, it is impossible for a human operator to control either his hand or a manipulator accurately enough to engage close-fitting parts by visual observation alone.

The third and still more complicated type of manipulation involves the operation of equipment. In this case

the controls or handles on equipment are generally limited to one or two degrees of freedom, and their path or axis of rotation is almost always determined by the equipment.

A simple example of this kind of manipulation is turning a crank. Although we usually think of this operation as being a very elementary manipulation to perform, it points out one other additional characteristic of the human arm that a manipulator needs if it is to perform this task successfully. It is clear that in turning a crank it is impossible for the brain to cause the hand to describe a perfect circle in the position of the crank on the equipment. The brain can, however, direct a force in approximately the correct directions to describe the circle. If the crank is free to turn, motion will be established, but the crank, not the hand, determines the circle.

Since the degrees of freedom of motion of the manipulator arm may be at any random position or orientation with respect to the degree or degrees of freedom of the controlled part on the equipment, some motions of the manipulator may have a positive force and yet be required to move in the opposite direction to accommodate the path dictated by the moving part of the equipment. For this accommodation to take place, six of the principal degrees of freedom of motion of the manipulator must be mechanically reversible.

HUMAN ENGINEERING: THE COMBINED APPROACH

It is necessary to take all of the features required to perform the various kinds of manipulations, together with the cybernetics of the human operator, and arrive at a set of specifications for the design of a good manipulative system. This can be called human engineering.

Since the manipulations to be performed by the mechanical arm are similar to those ordinarily performed manually, a logical arrangement is for the mechanical arm to duplicate the motions of the operator's arm or hand. A hypothetical arrangement would be a mechanical arm displaced from the operator's arm by a distance sufficient for a suitable shield. If the arm followed all of the motions of the operator's arm, had no mass, had no friction, and fed back all of the normal kinesthetic sensations, the operator could carry out manipulations with it the same as with his own arm and hand. The important difference from direct manual manipulation is that the optical path would be longer.

Such a system might be ideal from a human engineering point of view but is somewhat impractical and has more degrees of freedom than is necessary for general-purpose manipulation. The same general characteristics are preserved if the manipulator tongs are made to move in synchronism with the control handle even if the shape of the arm is considerably different from that of the human arm. Several manipulators based on this principle have been designed and are giving good performance.

To point out the importance of some of the features that man normally takes for granted, let's examine the condition if one or more of these features are missing or changed. Take, for example, the condition where the human hand and arm loses its senses of touch and force but with all other conditions normal. Such an arm would be like the "bull in a china shop," and a man having such an arm would not know or be able to control his own strength.

Consider another condition where all of the joints in the arm are replaced by nonreversible worm-and-gear drives. The arm would lose its bilateral characteristics.

A third point might be illustrated by crossing the nerve cables that transmit the stimuli from the brain to the arm muscles. In this case, it is believed that the action would be awkward at first, but the learning capacity of the brain could correct for these crossed circuits as experience was gained.

Since, in many types of manipulation to be performed, it is necessary for the operator to control motions and forces in six or seven independent degrees of freedom, it is concluded that the best and possibly the only way to obtain good performance is to capitalize on the cybernetics of the human arm. To do this, it is necessary for the manipulator to reflect forces back to the control handle in such a way that the kinesthetic sensations in the operator's arm can be readily interpreted. The simplest way to accomplish this, of course, is to make the mechanical arm a slave of the control handle, with fairly good synchronism. Force indications sent back to the operator's brain by means other than through his arm, such as by visual indicators, would be quite difficult to observe and interpret.

REQUIREMENTS TO BE MET

Based on the human-engineering approach, requirements for a good general-purpose manipulating system have been formulated.

Vision. Visual means should be provided to give the operator a three-dimensional view of the object and vicinity. Preferably the point of view should not be limited to small angles, nor should the operator be highly confined. At the present time large shielding windows are the only viewing devices that fulfill all of these requirements. Design and construction of these windows is discussed in the article on page 46.

Binocular periscopes have been built, but not in a

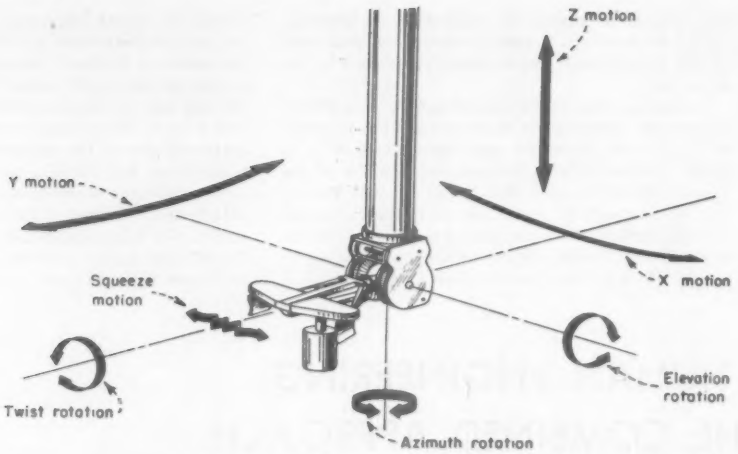


FIG. 4. Seven degrees of freedom shown by double-ended arrows are needed in manipulators

form that fulfills all of the above requirements. They generally lack flexibility and confine the eyes of the operator. Stereo television has been reduced to practice, proving the feasibility of such a system but also pointing out the need for further research and development to improve resolution and the blending of the two pictures. The possibilities look good.*

Degrees of freedom. The mechanical arm must have a minimum of three independent degrees of freedom of effective translation, three independent degrees of rotation, and an additional degree of freedom to open and close the tongs, as shown in Fig. 4. Additional degrees of freedom are often needed to change the shape of the arm, extend its working volume, add gripping motions or to eliminate "zenith" effects such as when two axes become parallel.

Control handle arrangement. The control handle and drives should be arranged so that the tongs are driven in or nearly in synchronism with the handle. The angles should be synchronous with errors not exceeding 20° or 30°. Experience has shown that errors greater than this confuse the operator, slowing him down and increasing his probability of making errors. These angles can possibly be increased if more training is provided.

Position synchronism is probably not as important as the requirements for preserving angles. Considerable changes in relative positions of the control handle and manipulator tongs give the operator little trouble.

Drive system. To fulfill the requirement for compliance or bilateral action needed when manipulating mating parts or operating equipment, the drive system for all seven principal degrees of freedom should be bilateral. This feature, when used with the control-handle arrangement already discussed, not only gives the manipulator compliance; it also reflects forces in a natural and intelligible manner.

A bilateral system referred to here is one that reproduces position and force from the input to the output or vice versa. Of course, the effective inertia and friction should be low. An efficient light mechanical linkage is one example of this type of bilateral system. Effective inertia loads in the translational motions up to 5 or 10 pounds do not seem to greatly interfere with the dexterity. Friction forces, however, must be held quite low—a small fraction of a pound.

Balance. Since the manipulator arm and control arm and handle necessarily have considerable mass compared to many of the objects that are to be handled, it is necessary to balance the system against gravitational forces.

Shape of mechanical arm and control-handle arm. The mechanical arm should generally have a long slender shape with a high strength-to-diameter ratio and a high strength-to-mass ratio. The arm may be on a polar coordinate system or rectilinear coordinate system.

A wrist joint having three degrees of rotation is at the end of the arm (generally the lower end). A pair of tongs, sometimes replaceable, are attached to the wrist joint. The wrist joint and lower portion of the arm should be as small as possible so that vision is not obstructed and so that the manipulator can work in close quarters around equipment. The arm on which the control handle is attached should have a shape similar to the manipulator arm so that similar motions will be established.

Mounting. The mechanical arm and control-handle arm must be mounted to some fixed reference and have the seven principal degrees of freedom with respect to this mounting. The mounting can, of course, be moved essentially to change the working volume of the manipulator or its orientation. The mechanical arm could be mounted on a remotely controlled vehicle to form a robot.

Tongs. It is impractical and almost impossible to provide the manipulator with a hand having the same degrees of freedom as that of the human hand. It is desirable, however, to provide the manipulator with a

* H. R. Johnston, C. A. Hermanson, H. L. Hull. Stereotelevision in remote control, *Electrical Engineering* **69**, 1,058 (1950), and *Electronics* **24**, 120 (1951).

pair of tongs which are suitable for grasping objects differing considerably in size, shape and weight.

Several attempts were made to devise fingers with only one degree of operating motion that would essentially wrap around the object. A better solution, however, appears to be tongs fitted with jaws that move parallel to each other. These jaws are generally lined with rubber to increase the coefficient of friction.

SATISFACTORY MANIPULATORS

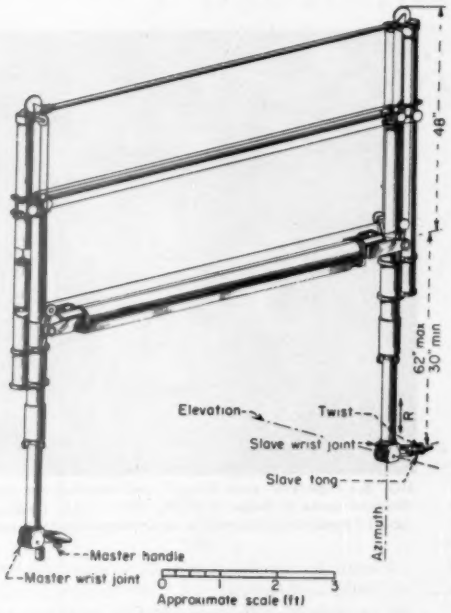


FIG. 5. First widely used master-slave manipulator, model 4. Load capacity is 5 to 10 lb

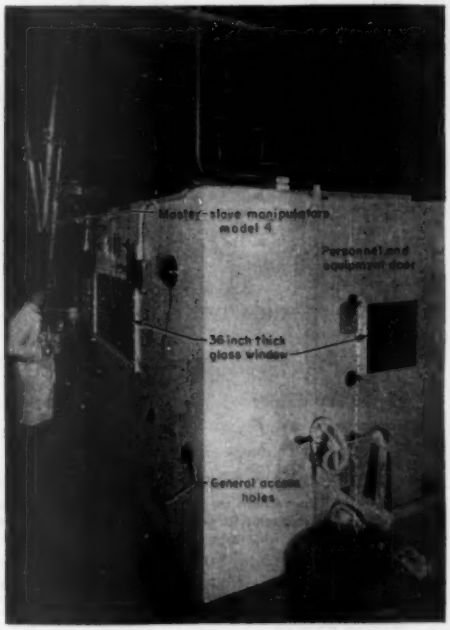


FIG. 6. Model 4 manipulator installed in cave. Hole is required in roof, limits activity levels to a few hundred curies

Several manipulators have been designed and constructed at Argonne National Laboratory which fulfill the desired conditions fairly well. They have been named master-slave manipulators because all the seven degrees of freedom of the tongs are slaved to the single master handle. All of the motions of these manipulators are connected by light, efficient mechanical linkages.

Figure 3 is an illustration of the master-slave manipulator, model 4. It is the first manipulator of this kind to receive wide popularity and use. The mechanical arm enters the shielded enclosure through a hole in its roof. The mechanical connections between the master handle and slave tongs consist of aluminum tubing, stainless-steel cables, Elgiloy tape, gears, etc. Counterweights are arranged so that the manipulator is balanced for all positions. Nearly all of the motions use ball bearings to keep the friction low.

Although the construction is very light weight, this manipulator has a load capacity of 5 to 10 pounds. The maximum load is primarily limited by the strength of the operator's hand. Quite often the operator uses two hands on one manipulator to get greater forces.

Figure 4 shows the manipulator installed in a small metallurgy "cave." The hole in the roof required for this manipulator limits the level of activity that can be placed in the cave to a few hundred curies of fission products. Special shielding and radiation traps can increase this level to a few thousand curies. A $2 \times 4\frac{1}{2} \times 3$ ft thick window made of laminated glass provides good general viewing.

DESIGN FOR HIGHER ACTIVITY

Another manipulator of this same general type is the master-slave manipulator, model 6. This manipulator has the same functional features as the model 4, but all of the connections between master and slave side pass through a large horizontal tubing.

Figures 5 and 6 show this manipulator installed in a high level physics-metallurgy "cave." This cave has sufficient shielding for several thousand curies of fission

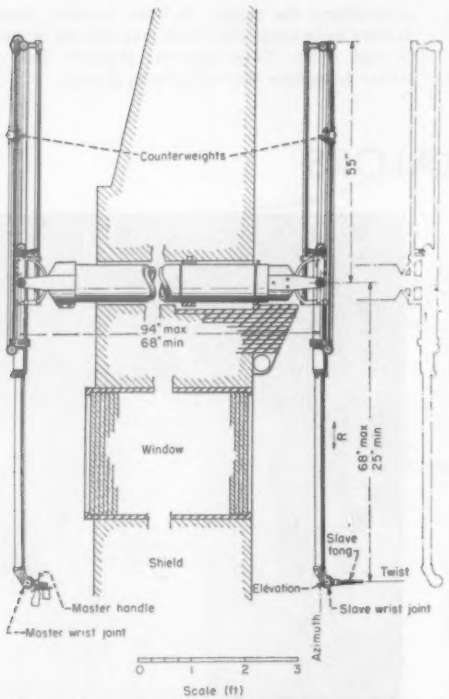


FIG. 7. All connections for model 6 master-slave manipulator can be made through a large horizontal tubing, allowing higher levels of radioactivity to be used than with the model 4

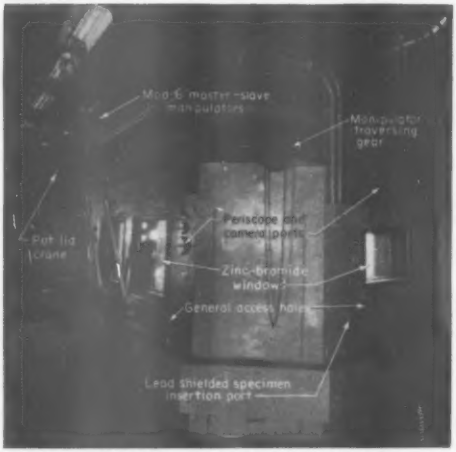


FIG. 8. High-level cave has sufficient shielding for several thousand curies of fission products. This is made possible by model 6 manipulator that needs only small opening for operation

products. Viewing for manipulation is through one of two $2\frac{1}{2} \times 3 \times 3$ ft thick windows filled with zinc bromide solution.

TRENDS IN FUTURE DESIGN

Mechanically coupled master-slave manipulators fulfill most of the specifications that are deemed important to be incorporated into a general purpose manipulator, but they have several limitations. Installation of these manipulators requires that the shielding enclosure be designed specifically to accommodate the mechanical connections of the manipulator. A second limitation is that the maximum load capacity of this kind of manipulator is limited by the strength of the operator's hand. A third, but less important limitation, is that the control handle must move through the same total volume that the mechanical slave arm moves through. A compensating factor is that the mechanically connected master-slave manipulators have relatively high performance and can be built at a fairly reasonable cost.

Additional models of mechanically coupled master-slave manipulators are being developed to change the general shape so that simpler shielding enclosures can be used. One example is a manipulator that can easily be inserted into a hole in a vertical shielding wall and work in a flexible contamination boot. It will be equipped with quickly replaceable tongs.

Electrically coupled master-slave manipulators are also under development. All of the mechanical linkages will be replaced with force-reflecting positional servos. The operation of these servos is explained in the article on page 43.

These servos can multiply force from one end to the other; for example, the manipulator may lift 100 pounds with the operator exerting a force of only 10 pounds. The servos may also have different displacement ratios so that the control handle may move less than the mechanical arm. This action will probably be accomplished by having the mechanical arm move approximately in synchronism with the control handle except when large motions of the manipulator are required. In this case the output motions would be a combination of position correspondence with indexing velocity added.

Bilateral servos of this general type can also be used to control delicate micro manipulators by having the reflected force multiplied and the output motions divided by a number greater than one. In this case viewing will probably be through binocular microscopes.

Arms controlled with these bilateral servos mounted on a remotely controlled vehicle can extend most of the manipulative skills of the human operator to almost any location. Robots equipped with these arms and with good stereo television will be capable of performing complex manipulations.

A Force-Reflecting Positional Servomechanism

By **Raymond C. Goertz**
and **Frank Bevilacqua**

TO BUILD MASTER-SLAVE type manipulators which do not require mechanical connections between the control handle and the mechanical arm, an electrically connected bilateral drive system is needed. The system must reproduce position from input to output, and reflect the output load back to the input. The entire system must also be completely reversible so that a force and a move-

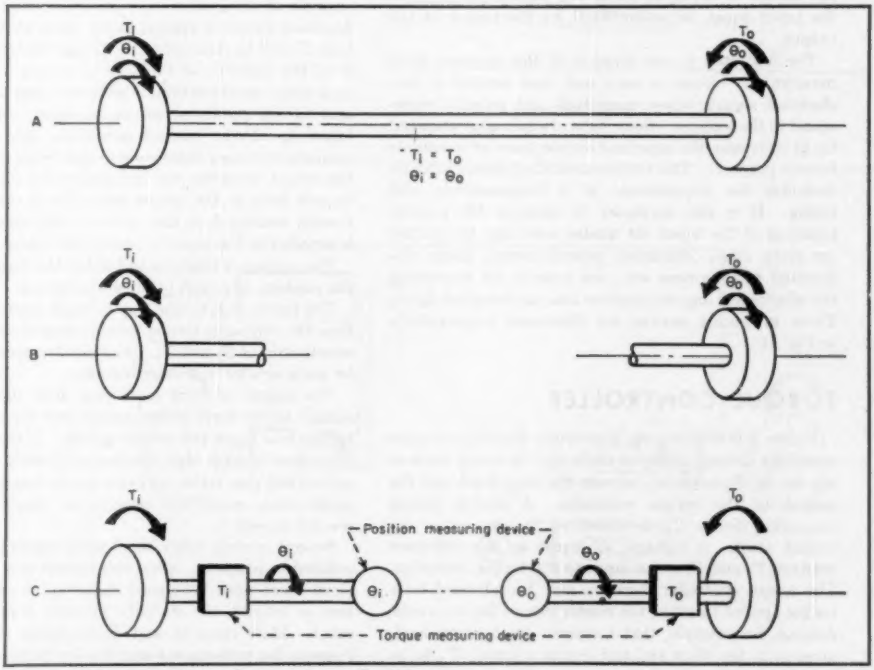


FIG. 1. Torque and angle motions for a force-reflecting servo

ment of the output will give a corresponding force and movement of the input member (knob or handle).

For the system to be useful for manipulator drives, it must have relatively low effective inertia and friction. At the same time it must reproduce force and position fairly accurately in a one-to-one relationship, or reproduce higher or lower forces on the input compared to the output. Similarly, the output motion may be required to move through a greater or lesser distance than the input. These requirements preclude the use of ordinary devices such as synchros, simple motor drives, or simple servo systems.

BASIC PROBLEM

Figure 1A shows the simplest type of bilateral drive—a rigid, low-inertia shaft that has very low friction. Assume that the knobs on either end have negligible inertia. Any angular input, θ_i, drives the output, θ_o, through an equal angle. Any torque output, T_o, reflects a torque, T_i, of equal magnitude. This system is ideal for a one-to-one force and position drive where mechanical connections can be used.

The basic problem is effectively to cut this ideal shaft in two as shown in Fig. 1B, but to maintain the original balance of torque, $T_i = T_o$, and position, $\theta_o = \theta_i$, using only electric wires between the two.

A solution to this problem is to provide a positional servomechanism at the output that will reproduce the position of the input, and to provide another servomechanism at the input which will establish a torque at the input equal, or proportional, to the torque at the output.

The first step in the solution of this problem is to measure the torque at each end, and convert it into electrical signals whose magnitude and polarity correspond to the torques. Some form of strain gage attached to, or built into, the input and output member is suitable for this purpose. This torque measuring system actually measures the displacement of a comparatively stiff spring. It is also necessary to measure the angular positions of the input (or master side) and the output (or slave side). Synchros, potentiometers, linear differential transformers, etc., are suitable for converting the mechanical angular position into an electrical signal. These measuring devices are illustrated schematically in Fig. 1C.

TORQUE CONTROLLER

Figure 2 is a schematic illustration showing a torque controller driving the input shaft, θ_i. A torque measuring device, T_i, is placed between the input knob and the output of the torque controller. A similar torque measuring device, T_o, is placed on the far end of the output shaft. A voltage, ϵ_T, equal to the difference between T_i and T_o is the input to the torque controller. The torque controller therefore may be activated by a torque applied to either the master side or the slave side. Assume, for example, that a torque, due to some load, appears at the slave end and causes a signal, T_o, to be generated. This signal, if not opposed by a corresponding signal from T_i, will cause the torque controller to drive the input shaft, θ_i, in the direction of the applied torque on the slave end. This motion will continue until a balancing signal, T_i, equal to T_o, is generated. The only way this can be done is for the master side to experience a load proportional to that on the slave end, such as a push against the operator's hand.

POSITION CONTROLLER

Figure 3 is a schematic illustration of the positional servomechanism which drives the output, θ_o, to correspond to the angular input, θ_i. Most of the principles of this servo are similar to those covered quite extensively in the literature.

The torque controller and the position controller, each comprising an amplifier, stabilizing networks, servo motor, gear train, etc., must have special characteristics to fulfill the needs of a high-performance master-slave manipulator. They must be capable of high accelerations, have fairly high natural frequencies, and be highly damped. Stability requirements are quite complicated for this system since any oscillations or perturbations in one servo are passed on to the other.

COMBINED SYSTEM

The combination of the two servo systems for a force or torque reflecting positional servomechanism is schematically illustrated in Fig. 4. The following is an example of what takes place in the double-loop system. Assume a torque is applied to the input knob. A signal from T_i will be received at the torque controller to drive θ_i in the direction of the applied torque. As θ_i turns as a result of this action, a positional signal, θ_i, will be sent to the positional servomechanism, causing θ_o to follow θ_i. Under no-load conditions, this motion will continue with very little input torque being required. If the output, however, encounters a load, a signal, T_o, will be sent back to the torque controller to cancel out T_i, thereby causing θ_i to slow down or stop unless a torque is supplied at the input to match the output load.

The system is bilateral and either the torque servo or the position servo can be on the input side.

The master-side torque may be made smaller or greater than the slave-side torque by adjusting the comparative sensitivities of T_i and T_o. In a similar manner, θ_i may be made smaller or greater than θ_o.

The torque or force measuring units must be close enough to the input master handle and the slave output to give true input and output signals. If the gain of the controllers is made high, friction and inertia of the servo motors and gear trains are overcome as long as maximum acceleration, maximum velocity, or maximum torque are not exceeded.

Several models, using small servo motors, have been reduced to practice. Since this system is a double-loop servo which must have good damping for all loads from zero to infinity, the stability problem is quite complicated. More research and development is needed to improve the performance and develop higher-horsepower systems.

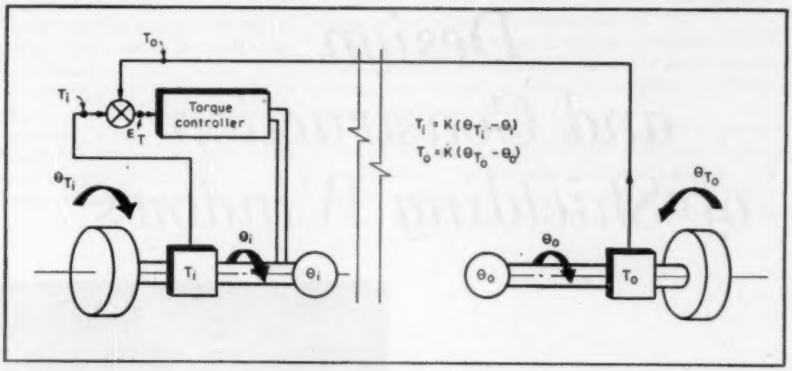


FIG. 2. Torque or force servo

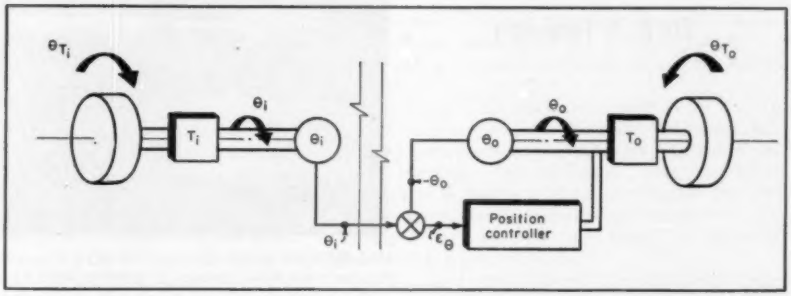


FIG. 3. Position servo

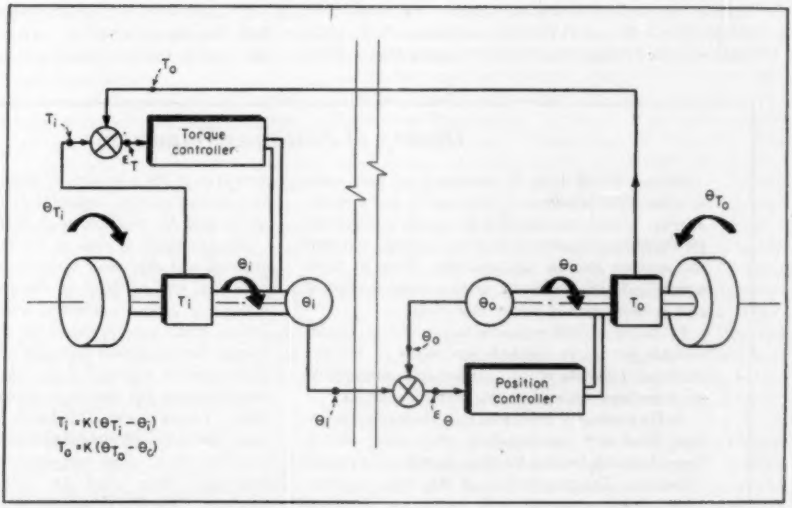
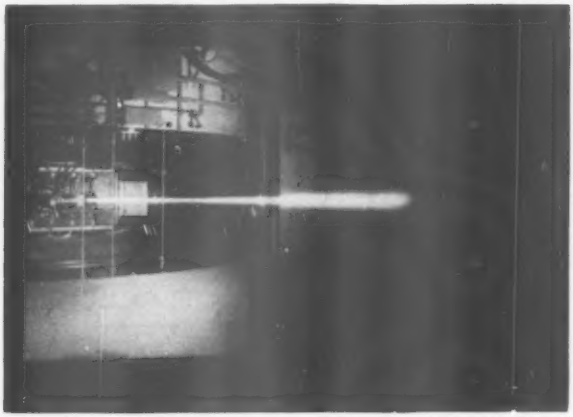


FIG. 4. Force reflecting servo

Design and Construction of Shielding Windows

By **K. R. Ferguson**



ZINC BROMIDE-WATER VIEWING WINDOW 7 ft. thick makes it possible to see Argonne's new 60-in. cyclotron in operation without radiation hazard

OBSERVATION of a procedure involving radioactive material is complicated by the necessity of seeing through or around the required biological shield. One solution to the problem is the use of shielding windows. A shielding window is an opening in a biological shield that is filled with an optically transparent material having the same radiation protecting properties as the surrounding shield.

To understand the use of shielding windows, familiarity with the requirements of a viewing system for remote observation and manipulation is needed. Such a system

History of Shielding Windows

During World War II occasional use was made of water-filled windows in laboratories using radioactivity. Some consideration was given to increasing the shielding effectiveness by using a nearly saturated salt solution such as zinc chloride. Prior to 1948, a few liquid-filled windows using a water solution of zinc bromide were in use at Oak Ridge.

In the fall of 1948, a general survey of dense liquids suitable for use in windows was made at Argonne National Laboratory (6). Subsequent development work has been centered on zinc bromide solution.

In the summer of 1948, tests were made of a window tank filled with one-inch-thick glass plates with a liquid laminate between the sheets to reduce the surface reflection. The possibilities of this type of glass-filled window appeared to be promising. Preliminary tests of the coloration of commercial lime glass by gamma radiation indicated that this glass could not be used for windows much thicker than one foot.

The utilization of glass as a transparent shielding material was dependent upon the development of a glass that was inhibited to coloration. In 1947, a number of glasses containing small percentages of cerium oxide were prepared by the Corning Glass Works; these withstood radiation very well. Because of the need for improved X-ray tube glass, other glass manufacturers had been experimenting along similar lines. In particular, Pittsburgh Plate Glass Company had been experimenting with a cerium-containing lime glass. Both companies supplied a "non-browning" lime glass for fabrication of thick windows. The first windows were assembled in 1949.

should in essence give the same visual impressions at the operating position as would be obtained by moving around inside the shield. These visual impressions depend on the following factors:

1. A wide angle of view and the ability to scan to provide an impression of over-all size and spatial relationships in two dimensions.
2. Depth perception to "round out" the view. This is a powerful aid in manipulation.
3. The ability to view from various vantage points and distances.
4. Color perception.
5. The ability to use optical aids for special purposes such as macro- and micro-examinations.

In addition, the image should be sufficiently free of distortion and other optical defects to allow prompt interpretation, and of sufficient resolution to permit perception of fine detail.

As will be seen in the next section of this article, viewing windows can satisfy most of the basic requirements listed. To overcome their shortcomings, such as the inability to use optical aids for micro-examination with them, periscopes or other viewing methods can be employed.

CAPABILITIES AND LIMITATIONS OF WINDOWS

Water, concentrated aqueous solutions, and glasses of various compositions have all been used in viewing windows. A simple and popular form of window in which these materials are used is a rectangular solid, although a frustrum of a pyramid is sometimes used. In either case, the optical faces are parallel, and the window is in effect a thick parallel plate.

In actual applications, these windows have exhibited many capabilities and some limitations; among these are:

1. They can provide shielding equivalent to as much as 4 ft of concrete for continuous exposure to gamma rays—more for intermittent duty.
2. The stability of materials other than water is not as well known for neutron as for gamma irradiation.
3. Apertures as big as 5 ft square are feasible. This allows the operator to move around quite freely while working. With a small shielded enclosure, this freedom can be used to achieve a variety of vantage points.
4. With a large enclosure, however, gross changes of vantage points require multiple windows and operator mobility. This may require multiple control stations for manipulative equipment or preclude the use of mechanically-connected manipulators.
5. With windows, more of the elements of normal vision are retained than with any other single viewing method. The field of view can approach 180 degrees, over which the eye can rapidly scan. Unimpaired binocular vision is retained with a minimum optical distance, since the optical thickness of the window for small angles of incidence is $1/n$ of the actual thickness, where n is the index of refraction of the window material. For objects close to the inner surface of the window, image size and depth discrimination are perceptibly increased.
6. Used in conjunction with master-slave manipulators, windows allow the use of standard, commercial apparatus for experimental-type work. Nearly normal operator-equipment orientation is maintained.

OPTICAL PERFORMANCE

One of the limitations of viewing windows is the slight reduction of the acuity and quality of vision that they cause. Three optical factors are affected: resolution, discrimination of color and contrast, and freedom from distortion.

Resolution. A window introduces chromatic aberration, spherical aberration, and localized optical imperfections, all of which contribute to a slight loss of resolution.

For vision with the unaided eye, most of the loss can be attributed to chromatic aberration and occurs only for viewing distances shorter than a few multiples of the window thickness. Looking through a 3-ft-thick window at an angle of incidence of 60 degrees, one can just measure the loss of resolution at an observer-to-object distance of 8 ft, although color fringes are definitely observable at greater distances.

For magnified vision through a window with a telescope, tests indicate that local imperfections are of minor importance compared with spherical and chromatic aberrations (*1*). Resolution can be increased by optimizing the aperture, that is, the diameter of the objective lens, of the telescope as the viewing distance is varied.

For apertures smaller than optimum, the resolution of the telescope-window system is reduced by the telescope; for larger apertures, by the window aberrations.

When objects closer than 100 ft are viewed under white-light illumination, the usable magnification drops rapidly as the angle of incidence is increased. The magnification approaches unity at an angle of incidence of 60 degrees. This magnification can be increased slightly by using monochromatic lighting such as that obtained from sodium-vapor lamps.

Discrimination of color and contrast. Color is important in most viewing. It can be preserved by using colorless window materials and white-light illumination. As pointed out in the previous section, the use of monochromatic lighting will increase the resolution that can be achieved in some cases. But because of the loss of color discrimination, this type of lighting is to be desired only where the use of white light would actually interfere with observation.

Object lighting contrast is a paramount optical factor in the discrimination of detail. With good window materials and designs, the existing contrast will not be altered perceptibly. Haze in liquid windows, incomplete

polish on glass surfaces, and multiple surface reflections are some of the factors that must be controlled to preserve contrast. These factors are discussed in later sections.

Distortion. A window introduces distortion that curves plane surfaces because the apparent distance of objects is a function of the window thickness along the line of sight. This curvature is severe only when the viewing distance approximates the window thickness, or when viewing at an angle of incidence greater than about 60 degrees.

TRANSPARENT SHIELDING MATERIALS

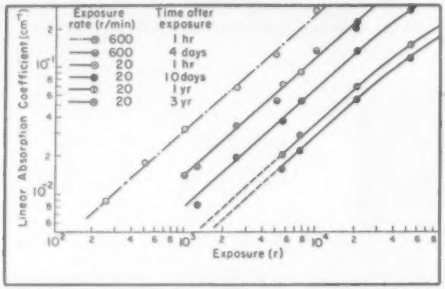


FIG. 1. Increase in linear absorption coefficient of commercial lime glass with Co^{60} gamma irradiation. Coefficient values are for the transmittance of sodium light. Exposure is average received by volume of air occupying same position as glass

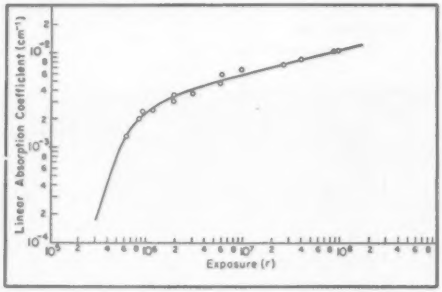


FIG. 2. Increase in linear absorption coefficient of nonbrowning lime glass with Co^{60} gamma irradiation. Coefficient values are for the transmittance of tungsten light. Exposure rate was 4×10^4 r/hr

The material used for a window should have approximately the same shielding effectiveness per unit of thickness as the rest of the biological shield. Interest has been concentrated, therefore, on materials with half-value layers comparable to those of concrete, steel, and other common shielding materials.

A second requirement is that the window material have such desirable optical properties as: a high transmission of at least a portion of the visible spectrum; freedom from imperfections such as local variations of index of refraction (strise); a minimum of haze or turbidity; and a high index of refraction, to permit a large angle of view through a small window aperture.

A third requirement is stability of color and clarity against both time and intense radiation. Further factors for consideration are the installed cost of the window, and the radiation hazard and possible toxicity of the window material in case of breakage.

Several transparent shielding materials satisfy weighted versions of these requirements.

WATER

The logical choice for economy and radiation stability is distilled or freshly filtered water. Advantages are that it is sufficiently clear to permit excellent vision through thicknesses of 10 ft or more, cheap enough to be attractive in spite of the larger size required by its low density and index of refraction, literally water-white, and virtually unaffected by gamma or neutron absorption.

Its low density does require a window 2.5 to 8 times as thick as an alternative glass or dense liquid window, however. Perception of detail for objects near the window is correspondingly impaired. For installations far from the window, lower density is of less disadvantage.

For a given angle of view, a water-filled window requires a greater aperture through the shield. This will require larger and thicker cover plates—in extreme cases, multiple panes strengthened by mullions.

Deposits and cloudiness have been observed in some windows filled with filtered water. This is not well understood, and the need to replace the water and remove the cover plates for periodic cleaning should be anticipated.

ZINC BROMIDE SOLUTION

A water solution of zinc bromide is in current widespread use as a window material (*2*). A general specification has been developed for the requirements of the "optical grade" solution (*3*). Some properties of the zinc bromide solution are listed in the table. The solution density is 2.50–2.54, corresponding to 77.0–78.3% dry weight of zinc bromide (16.0–16.6 lb of dry zinc bromide per gallon of solution). The density range of the solution has been chosen to give a freezing point approximately that of water. This allows the solution to be shipped by common carrier with ordinary precautions against freezing.

At the current dry-weight price of zinc bromide, \$0.78/lb, the average price of the solution is \$13/gallon. With material of the quality currently being produced, it is no longer necessary to provide for periodic filtering.

The light transmission of the solution is excellent, and the thickness of a window is limited only by the radiation stability of the solution.

Hazes. Occasional difficulty has occurred with haze formed by the slow precipitation of alkaline earth sulphates. Barium, strontium, and calcium have been identified, and the haze is attributed to mixing different production batches of solution. However, metallurgical

experiments were continued behind a 3-ft window while such a haze formed and settled out after 9 to 12 months.

Oxidation. Contact with the air or exposure to radiation can cause oxidation. In either case the solution will be deeply colored by the oxidation of only a few parts per million of iron. In the absence of any reducing agent, exposure to radiation will liberate free bromine from the solution.

To prevent these effects, a reducing agent is added whose oxidation products introduce neither color nor haze to the solution. Hydroxylamine hydrochloride, $H_2NOH{\cdot}HCL$, is satisfactory in this respect. The addition of 4 ounces per 100 gallons of zinc bromide solution will protect a thin layer of the solution from a 10^6 r exposure. In a thick window, relatively unexposed solution on the operator's side will be mixed (stirring may be required) with exposed solution from which the reducing agent has been exhausted. On this basis, an exposure to Co^{60} radiation of about 10^7 r will be required to consume this reducing agent in a 3-ft-thick window.

The gaseous oxidation products of hydroxylamine are somewhat soluble in the zinc bromide solution, but incident exposures of 10^5 to 10^6 r within 24 hr. will certainly cause gas evolution. If the bubbles rise rapidly the effect may not be serious.

The sulfide-ion concentration in the zinc bromide solution can be kept below a few tenths part per million by completely oxidizing the solution during its preparation. Unless this is done a haze of free sulfur, which will not be reduced by the stabilizer, will form.

Contamination. Hazes and coloration can also be caused in zinc bromide solutions by contaminants dissolved from the walls of the window tank. Nickel and cobalt are soluble in and impart color to the solution. Chromium from dissolved stainless steel will slowly precipitate and form a haze. Many organic materials will impart strong color and produce dense hazes.

Contamination and its effects can be eliminated by allowing only materials that have not exhibited contamination in tests lasting a year or more to come into contact with the solution. Polythene, Tygon, Koroseal (all types), and hard rubber can be used for limited periods, preferably less than one day.

Whenever feasible, a seven-coat application of Amercoat 31 over hot-rolled steel is recommended because of its superior resistance to zinc bromide, ease of application, and economy. Lithcote, Teflon, and silver are also satisfactory; Koroseal 9234, copper, stainless steel 347, and brass are suitable for limited periods.

OTHER DENSE LIQUIDS

A number of other dense liquids and aqueous solutions have been considered as prospective window materials. The list includes: lead acetate, zinc chloride, methylene bromide, acetylene tetrabromide, a mixture of stannic bromide and stannic chloride, barium and mercuric bromide, and cadmium borotungstate (*2*). Further development might improve the competitive position of some, but most have been ruled out for reasons of low density, high cost, instability, or toxicity.

SHIELDING GLASSES

The pertinent properties of some commercial glasses suitable for shielding and some shielding glasses now in the development stage are listed in Table 3. Other properties of nonbrowning lime glass have been specified elsewhere (*4*).

Glass may be manufactured for windows in the form of polished plate or as cast sections. The maximum practicable sheet size for production of 1-in.-thick plate glass with suitable optical quality is about 5 ft square.

X-ray lead glass is manufactured in ¼-in. thickness only, but it can be laminated with plastic sheet to a 3-in. thickness. The largest castings of dense lead glass with good optical quality have been 400 in^3. Larger glass castings are still in the preproduction stage. It is believed that castings as large as 36-in. square and 4- to 6-in. thick will be feasible.

Radiation tests. The factors that influence the change in light transmission of glass exposed to gamma radiation include: (1) exposure rate and total exposure;

Physical Properties of Transparent Shielding Materials

Type	Density	Index of refraction	Optical transmittance* Tungsten†	Optical transmittance* Sodium	Color	Radiation stability index‡	Fading index§	Price per pound‡‡
Commercial lime¶	2.52	1.52	94.6	94.3	Green	2.6×10^3	2–5	$0.50
Water-white lime¶	2.52	1.52	99.0	99.0	Colorless	2.6×10^3	2–5	1.25
Nonbrowning lime¶	2.68	1.53	96.8	97.0	Light yellow	1.6×10^4	1–3	2.25
Corning 8362	3.27	1.59	97.6	98.2	Yellow	0.8×10^4	1–3	....
X-ray lead¶‖	4.88	1.76	90.0	92.0	Deep yellow	2.0×10^3	2–5	2.50
Dense lead**	6.20	1.98	94.1	95.2	Yelllw-orange	1.5×10^3	10–50	4.00
Zinc bromide solution††	2.52	1.56	98.5	99.0	Colorless	.....	.....	0.60

* Optical transmittance in per cent for 1-in. thickness and average specimens, less surface reflection.

† Light of the quality of I.C.I. Illuminant A.

‡ The exposure in r required to produce a change in optical density of 0.01, for white light and a thickness of one half-value layer. Optical density is the common logarithm of the reciprocal of the transmittance. The exposure rate was 100 and 700 r/min.

§ The ratio by which the exposure must be increased in order that the change in optical density is 0.01, two weeks after the termination of the exposure.

¶ Commercial samples from the Pittsburgh Plate Glass Co.

‖ Transmittance and price are for laminated sections.

** Commercial samples from the Penberthy Instrument Co. A similar glass has been prepared experimentally by the Corning Glass Works.

†† Commercial samples from Dow Chemical Co.

‡‡ Approximate prices as of September, 1952.

(2) continuity of exposure; (3) time elapsed between exposure and transmittance measurement; (4) temperature during and following exposure; and (5) for some glasses, the amount of visible light incident on the glass during and following exposure (*5*).

Figure 1 shows the change in the linear absorption coefficient of commercial lime glass when exposed to gamma radiation. All samples were kept at room temperature and in darkness during and after exposure.

Figure 2 shows the change in linear absorption coefficient for nonbrowning lime glass caused by gamma irradiation.

CONSTRUCTION OF WINDOWS

Three window constructions developed over the past several years will be discussed. These designs are typical and represent the best current practice for their respective types. In each of these designs, radiation effects, thickness, lighting requirements, and viewing area have been considered.

Radiation effects. The controlling consideration is the effect of radiation on all of a window's components, including tank lining materials, gaskets, and laminating liquids, as well as the transparent shielding material. The performance of complete window assemblies in gamma-ray shields with thicknesses equivalent to as much as 4 ft of concrete has been well tested in operation.

Thickness. Bulk shielding tests made on hot-laboratory installations indicate that the gamma-shielding properties of ordinary concrete, magnetite concrete, zinc bromide, lime glass, and steel can be compared approximately on the basis of specific gravity alone. Lead glasses, however, are better shields than indicated by their specific gravities. One glass with a lead oxide content of 80% and a specific gravity of 6.2 is equivalent to steel for 1-Mev radiation.

Lighting. The same considerations are involved in lighting a shielded enclosure as in lighting any other. Proper weight must be given such factors as brightness, diffusion, and elimination of objectionable shadows.

Once a satisfactory level of illumination is determined, it is necessary to increase the level to allow for the absorption of the window. The initial transmittance values should be reduced to correct for the ultimate radiation darkening of the glass sections of the window.

Area. The minimum window area depends on the desired degree of freedom in observer or equipment position. For a small piece of fixed equipment, the narrow cone of vision through a quite small window will suffice. If the observer is free to move from side to side and up and down to "scan" a larger angle, the next smallest aperture, whose frontal dimensions are easily calculated from the index of refraction of the window material, will result. If the same angle must be scanned from a more fixed vantage point, the aperture at the inside face of the shield will be twice as large; the window in this case may be pyramidal, however, with a volume about equal to that for the second case. If the operator must have freedom to move about coupled with wide coverage of the interior, as with a manipulator, the aperture must approach the size of the working area.

ZINC BROMIDE WINDOW

Figure 3 shows a zinc bromide window, 30 × 36 × 36 in. thick, sealed in a concrete wall by means of a liner which is cast directly into the wall. The use of a removable window allows it to be assembled in a room with special facilities and to be installed in the shield without interruption of other construction activities.

The crack between the window tank and the liner is shielded by a step made of lead which is held in place by strips of steel over the lead. When neutron radiation is present, cracks must also be calked tight.

The window tank is fabricated from hot-rolled steel plates with minimum of welding (intermittent structural welds on the outside and light seal welds on the inside) to

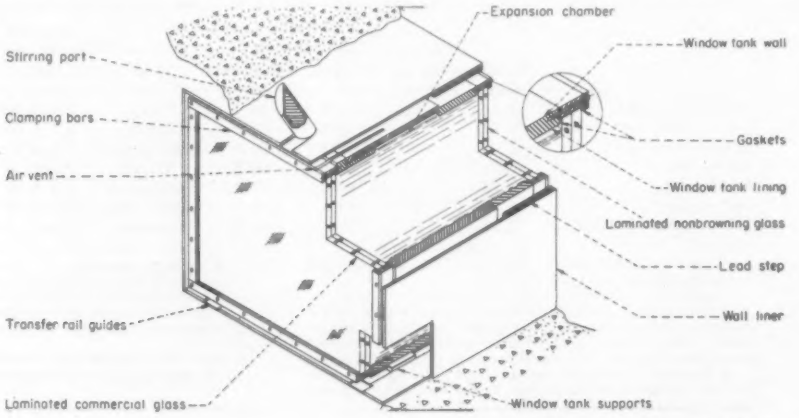


FIG. 3. Construction details of zinc bromide window

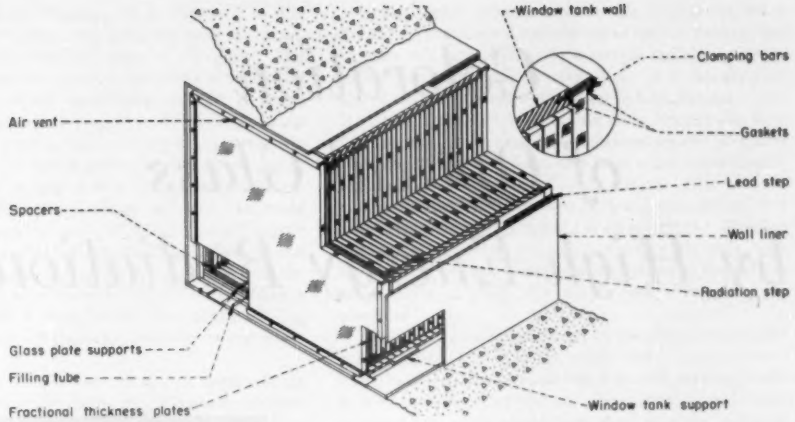


FIG. 4. Construction details of glass window

decrease the possibility of warping the frame. Major machining is required only on the ends of the tank to form the gasket seats.

The type of clamping arrangement illustrated here requires a minimum thickness (1¼ in.) of tank wall. The clamping bars are not joined together at the corners so that each may seat individually. The gaskets that come in contact with zinc bromide should be fabricated from Koroseal (grade 116, B. F. Goodrich Co.); the inside gasket should be continuous and cut from sheet stock.

It is desirable to laminate the glass cover plates. In large windows it is required for strength, but it is always desirable as a safeguard in case one plate is damaged. The glass may be tempered for still greater strength.

Provision should be made for the thermal expansion of the liquid. The coefficient of cubical expansion for zinc bromide is about 0.6×10^{-3}/° C. For a temperature change of 20° C, a volume change of 1.2% results. If an external expansion tank is used, it should be located directly above the window tank and should be of minimum height so as not to increase the hydrostatic pressure on the glass cover plates excessively. An internal expansion space is a satisfactory arrangement. The air vent on an internal or external tank should be kept free at all times.

Striations will be encountered in the zinc bromide solution when originally filling the window tank or when making adjustments to the liquid level. These striations can be removed by stirring the solution for a short time. A stirring port, as shown in Fig. 3, is convenient. A 1.5- to 2-in. pipe is lined with copper tubing which is silver-soldered to the main tank wall. The Amercoat paint is lapped well up on the copper to cover the joint. A steel plug is shown in the stirring port to cover the slot in the wall required to accommodate the port.

GLASS WINDOW

Figure 4 illustrates a glass window 30 × 36 × 36 in. thick. The glass used here is 1-in.-thick plate glass. The surface reflections from the many plates are almost completely removed by filling the space between plates with a mineral oil with an index of refraction about equal to that of the glass. This space between the plates is maintained by soft copper spacers at the four corners. The thickness of the spacer is 0.025 to 0.035 in. Since the oil is of lower density than the glass, the crack between the glass and tank wall must be stepped.

The glass plates are supported on ¼-in.-thick strips of Koroseal, grade 116. Koroseal also can be used for the gaskets.

Because of the variation in thickness of the glass plates, the window might not be filled with an integral number of plates. Any remaining space should be filled with ½- or ¾-in. plates or a combination of both. If they are installed on the operator's side, these fractional-thickness plates may be commercial plate glass.

After the tank is sealed, the oil is introduced slowly through the lower filling tube. A slight space is letf at the top of the tank for thermal expansion.

COMPOSITE WINDOW

Combinations of transparent materials may be used to achieve a window with properties not possible with any single material. In some high-level applications it will be necessary to use nonbrowning glass instead of zinc bromide on the active side of the window to prevent bubbling of the solution. The use of dense lead glass on the operator's side will reduce the window thickness and the size of the window required to view a given area. In addition, these glass sections afford some protection to personnel in case of sudden loss of the liquid shielding.

A composite window thus consists basically of zinc bromide solution, used for its optical quality and economy, supplemented by nonbrowning glass for radiation stability, and dense lead glass for reduced size.

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Coloration of Optical Glass by High-Energy Radiation

By George S. Monk

NONDARKENING LIME GLASS has been developed in cooperation with a number of industrial firms. Glass cylinders in top row were exposed to from 0 to 140,000 roentgens. Treated glass in bottom row has been exposed to from 0 to 10-million roentgens

TRANSMISSION OF LIGHT through many standard optical glasses is sharply diminished by the coloration produced in them by high-energy radiation. This seriously limits the use of optical instruments with highly radioactive materials.

Modification of the glass formulas by addition of cerium oxides, has made it possible to produce glass with the required optical characteristics that does not color even after exposure to as much as 10^8 roentgens. Work at the Metallurgical Laboratory, University of Chicago, and at Argonne National Laboratory, coupled with data from glass technology, has led to the formulation of a qualitative theory of coloration and its inhibition. During the development of noncoloring glass, the effect of radiation on other optical materials was also studied.

Uses of noncoloring glass. In work with high levels of radioactivity, operations are carried out behind thick shielding walls or at great distances. In all cases where detailed viewing is required, involving the use of optical instruments or windows close to the radioactive material, noncoloring glasses are essential. If television is used, optical lenses are needed for the camera.

Other uses also exist. Chemical glassware and radioisotope containers that do not darken would be useful in experiments with radioactivity. If fission products are used for sterilization of foods and drugs, the use of glass containers that do not discolor when irradiated would make the product more attractive and salable.

QUALITATIVE THEORY

No theory of glass coloration and its prevention has been proved quantitatively. Current theories and terminology in the field stem from the theories of ionization in alkali halide crystals. But, according to theories first summarized by Zachariasen (*1*), glass has a network structure. The theories developed for crystal structures cannot be extended to glass *per se*.* The qualitative theory suggested here is subject to further experimental proof.

* That glass is not entirely perfectly random in structure is indicated by later research, but the randomness is sufficient to remove it from ordinary crystal form.

In a discussion of coloration, it is necessary to distinguish between it and the intrinsic color of glass. Intrinsic color is the original color of the glass. The technology indicates that the intrinsic color is caused by absorption bands of the constituent oxides. A single oxide is not always responsible; other oxides present may cause the first to exist in either of two or more valence states, each of which has a particular absorption band.

Coloration may be defined as a change in the absorption of visible light. High-energy radiation can cause such a change in several ways, of which two are important. First, as in the alkali halides, radiation can displace electrons which then lodge in "holes" in the structure and form color centers. Second, it can change the valence state of a multivalent oxide, thus changing its absorption band. This is an oxidation or reduction process.

Available evidence indicates that if, in a given volume of glass, there is a metallic oxide which is easily changed in valence (Fe_2O_3 to FeO, for instance), the energy of the radiation is used not to displace an electron to form a color center, but to change the valence state of the most easily affected multivalent oxide.

A number of multivalent or bivalent oxides could thus act as inhibitors of coloration by electron displacement. This is the case; oxides of Cr, Mn, Ce, As, Sb, and Fe retard coloration by high-energy radiation. Unfortunately, most of these have absorption bands in the visible spectrum in either or all valence states. Glass containing these oxides is thus not intrinsically colorless.

Both CeO_2 and Ce_2O_3 have their absorption bands in the near ultraviolet, however. Furthermore, not much energy is required to cause a shift in valence. A tentative explanation of why cerium is a good coloration inhibitor is that high-energy radiation causes a shift from ceric to cerous oxide, with no consequent introduction of a visible absorption band.

Experimental confirmation of this hypothesis exists in the fact that a specified amount of cerium oxide added to glass will protect it up to a certain radiation dosage; higher dosage then causes coloration. A higher percentage of the oxide protects the glass to higher doses. The inference is that after all of the ceric compounds have been changed to cerous, the additional energy displaces electrons from the sodium, silicon, or other constituents, leading to the formation of color centers.

Arsenic and antimony also have colorless oxides, but they are not as good as cerium as an inhibitor. This has not been explained as yet, but it probably has to do with the stability of their compounds compared to that of the constituents of glass. No simple generalization is yet possible.

The role of other ingredients in the glass is extremely complicated. For instance, while many trials indicate that the inclusion of arsenic together with cerium results in poor intrinsic color and also a reduction of resistance to coloration, some recent tests show that the inclusion of a small amount of arsenic in a cerium-stabilized glass helps prevent coloration. Possibly the melting process is also involved in these seeming discrepancies.

FADING

Coloration produced by radiation often fades under normal conditions or when the glass is exposed to heat or another form of radiation. Fading is essentially due to the return of displaced electrons to their normal positions.

The amount of coloration depends, therefore, not only on changes caused by high-energy radiation. If fading proceeds at the same rate as coloration, the glass can be said to be noncoloring. A study of this aspect of inhibition of coloration has been initiated. It is possible, in work where optical instruments are intermittently exposed to radiation, to take advantage of the fading of coloration.

COLORATION EXPERIMENTS

In a preliminary series of experiments, spectrophotometric studies were made of common optical glasses that had been irradiated inside the shield of the Clinton reactor. Almost universally, transparent optical glasses become colored by the growth of absorption bands, principally in the short-wavelength region. Enough was known about the problem to believe that coloration was independent of the particular sort of radiation used. This was justified by the results.

One exception was boron-containing glasses. This was attributed to a phenomenon named the "edge effect," which will be discussed later.

Since the degree of coloration varied among the glasses tested, an attempt was made to correlate the composition of the glasses with the amount of coloration. No absolute correlation was found among all the glasses, although several were suggestively strong.

One sample of a crown flint, containing a higher-than-usual percentage of antimony oxide, exhibited little coloration. The role of antimony as an effective modifier of ultraviolet transmission and even of intrinsic color in glasses had been well known for some time in the empirical research of glassmaking. This led to a consideration of the possibility that it or other oxides might be used as inhibitors of coloration due to high-energy radiation.

PROTECTED OPTICAL GLASS

In 1947, Corning Glass Works supplied a variety of glasses containing antimony and other multiple-valence oxides. Those containing a small percentage of cerium oxide withstood radiation very well.

The use of cerium oxide to prevent coloration was propounded in a patent by Montgomery (*2*) in 1925, and by Eckert (*3*) in 1926. Pittsburgh Plate Glass Company has been experimenting for a number of years with cerium-containing glasses. Both Pittsburgh and Corning have supplied ordinary noncoloring lime glass for use in viewing windows.

This production of noncoloring lime glass does not

solve the problem of obtaining optical glasses, however. An exceedingly wide variety of constituents are used in optical glass to give the characteristics required by present designs in optics. Unless noncoloring glass could be produced with these same characteristics, much redesign of optical instruments would be necessary.

Experiments continued, and after many trials, Corning produced a quantity of experimental glass samples. The compositions of five of these glasses are given in Table 1. Each sample contained a small percentage of cerium oxide in addition to the constituents shown. These were irradiated at the same time as samples of the equivalent unprotected optical glasses. The results are shown graphically in Figs. 1–5. The values plotted were obtained by readings with a visual spectrophotometer in comparison with unirradiated samples. The transmissions of the unirradiated samples were in turn measured directly, using daylight as a source.

Lead glasses. The extra-dense flint, containing 62% lead oxide, (Fig. 5) illustrates also that flint glasses are more resistant to coloration. The dense flints are characterized by an intrinsic yellow color, the depth of color depending on the lead content. The commercial glasses in this group withstand coloration quite successfully, the degree of success also depending on the lead content. Addition of cerium increases both the intrinsic yellow color and its enhancement by coloration.

It seems possible that dense lead glasses should be made with the present ingredients without the addition

TABLE 1—Composition of Five Experimental Glasses

Glass	SiO_2 (%)	PbO (%)	BaO (%)	CaO (%)	Al_2O_3 (%)	ZnO (%)	Na_2O (%)	K_2O (%)	As_2O_3 (%)	BaO_2 (%)
Light barium crown—I	50.0		30.0			4.1	3.2	10.3	0.3	3.4
Light barium crown—II	48.1		29.5	0.15	0.65	9.0	1.0	7.5		4.0
Dense barium crown	40.0		42.3	Trace	3.0	8.0	Trace	Trace		6.0
Crown	62.0	1.0	11.0			3.0	5.0	15.0		2.0
Extra dense flint	34.0	62.5						3.0	0.3	

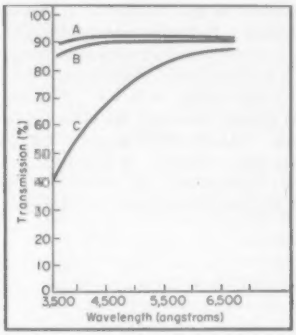

FIG. 1. Light Barium crown—I

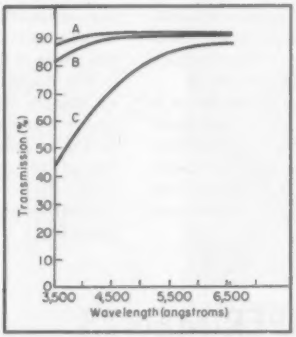

FIG. 2. Light barium crown—II

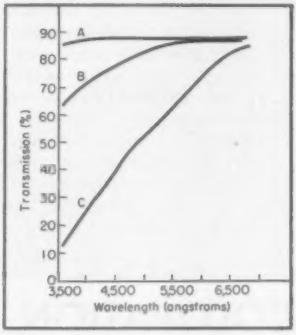

FIG. 3. Dense barium crown

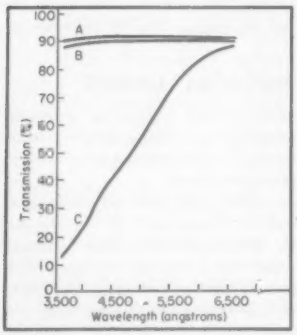

FIG. 4. Crown

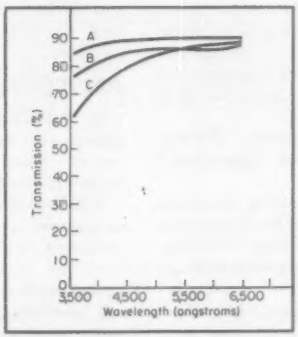

FIG. 5. Extra dense flint

Comparative colorations of five protected and unprotected optical glasses

A: unirradiated sample
B: irradiated protected sample
C: irradiated commercial sample

TABLE 2—Composition of Glasses that Show Edge Effect

Glass	SiO_2 (%)	B_2O_3 (%)	BaO (%)	PbO (%)	Al_2O_3 (%)	As_2O_3 (%)	La_2O_3 (%)	TaO_2 (%)	WO_3 (%)	ThO_2 (%)	SrO (%)
A		30.0	12.0				28.0		18.0	12.0	
B	2.0	50.0		38.0	10.0	Trace					
C	2.6	37.4	14.0				20.0			20.0	6.0
D		30.0	12.0				28.0	18.0		12.0	

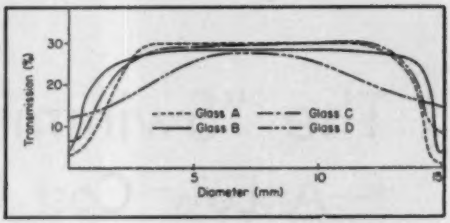

FIG. 6. Comparative edge effect darkening in four boron-containing glasses

of cerium. This conclusion may not be justified since both the intrinsic color and coloration by radiation seem to depend on other constituents of the glass as well as on the amount of lead. Experimentation may disclose more suitable compositions than those in standard commercial glasses.

Pilot production. After the initial success with partial inhibition of coloration of optical glass, Corning was asked to supply sufficient optical glass for fabrication of lens elements for hot-laboratory periscopes.* Three glasses were furnished in lots of about 4 lb each: light barium crown, index 1.572, dispersion number 57.4; borosilicate crown, index 1.517, dispersion number 64.5; and extra-dense flint, index 1.648, dispersion number 34.1.

Samples of each of these were irradiated with an 80-curie Co^{60} source, the total dose being 2×10^6 roentgens. The light barium crown glass was slightly colored. Preliminary measurements indicate a drop in visual transmission of about 4.5%, principally for the shorter wavelengths. No change was found in the borosilicate crown glass, which in unprotected form is one of the glasses most affected by coloration. The extra-dense flint glass is intrinsically slightly yellow; it developed some coloration that faded rapidly.

Cerium content. From 0.25 to 1.5% cerium oxide was used in these glasses. The amount used has to be limited because, although the peaks of the absorption bands are in the ultraviolet, the wings of an intense band may extend into the visible, absorbing the blue and causing a glass to be intrinsically yellow. Arsenic was omitted from all these melts.

EDGE EFFECT

Irradiated samples of unprotected glass containing boron showed a marked darkening at all edges, decreasing in coloration from the face of the glass toward the inside. This has been termed the edge effect. Spectrophotometric measurements of four samples, corrected for reflection, are shown in Fig. 6, and constituents of the samples are given in Table 2. Only approximate figures were available for samples *A*, *C* and *D*. It is evident, however, that the amount of boron is not the only factor influencing the edge effect.

Pure boric oxide glass, made with the purest powder available and fused in a platinum crucible, did not develop coloration when similarly irradiated.

The effect can be said to be caused by alpha particles emitted by boron made radioactive by thermal neutrons. This hypotheses is supported by the fact that boron-containing glasses irradiated with fast neutrons or gamma rays do not exhibit this effect. Boron glasses protected with cerium oxides do not exhibit any edge effect.

OTHER OPTICAL MATERIALS

Because of the increasing use of other materials in optics, the effects of radiation on some of them were investigated in these studies. Extensive tests were made on other optical materials, including calcite, natural and artificial fluorite, Polaroid, silicas, silicones, and plastics. Natural and artificial crystals vary so much in impurity content that the results were widely divergent from one sample to the next.

Plastic lenses. Preliminary experiments with Lucite indicated that its resistance to coloration was 500 to 1,000 times greater than that of ordinary optical glass. However, correction of lens aberrations requires the use of more than a single index of refraction and dispersion. Polaroid Corporation has made excellent achromats using cyclohexyl methacrylate (index 1.5062, dispersion number 56.9) together with polystyrene (index 1.5915, dispersion number 31.0) in place of the usual crown and flint glasses.

Samples of these materials were irradiated in the Argonne reactor. With an inordinate amount of exposure, the cyclohexyl methacrylate took on a faint yellow color. Unlike most glasses it did not fade after removal from the reactor, however. The polystyrene became a muddy yellow-brown after prolonged reactor exposure, but remained clear with gamma radiation exposures as high as 2×10^6 r.

Polystyrene formulated without using benzoyl peroxide as a polymerization initiator became only pale yellow with reactor irradiation.

* * *

This article has been adapted and abridged from Argonne National Laboratory report ANL-4536 (1950).

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* Experimental samples also have been prepared by Bausch and Lomb Optical Company. Recently a program of research on noncoloring optical glasses has been started at Bausch and Lomb under the sponsorship of the Atomic Energy Commission.

The "Swimming Pool" —A Low Cost Research Reactor

Slightly over $200,000 would be needed to construct and house this particularly safe reactor that provides wide flexibility for research. Reactor and its controls cost $61,000 when prototype was built in 1950

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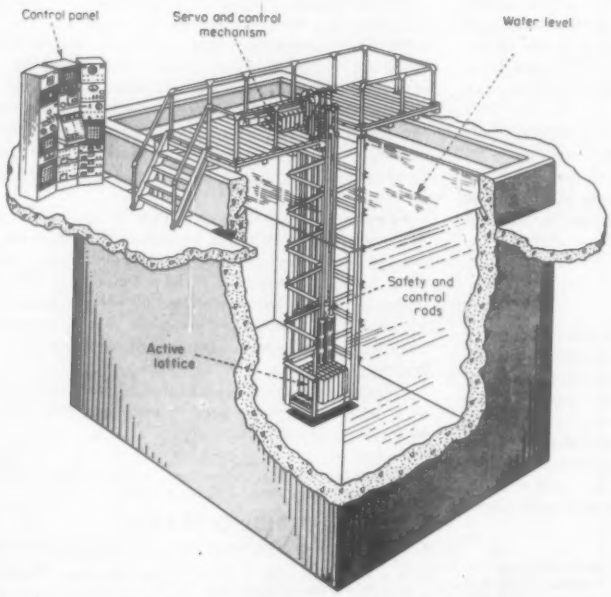

FIG. 1. Three-dimensional view of low cost reactor

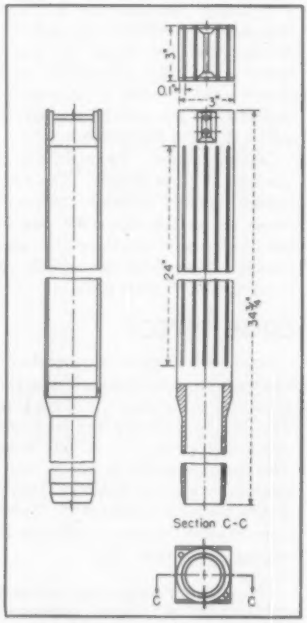

FIG. 2. Fuel element for low cost reactor

TWO REACTORS suitable for installation in schools and other installations where a copious source of neutrons is needed for research are now operating in this country. A modified version of one of these—the "swimming pool" reactor (*1*) in the Bulk Shielding Facility at Oak Ridge National Laboratory—is described in this article. The other suitable reactor is the aqueous, homogeneous reactor (*2*) developed at Los Alamos Scientific Laboratory.

A chain reactor of the swimming pool type is relatively so inexpensive to construct and simple to operate that its installation is hardly a major project. Declassification of the design of the ORNL facility makes a description possible, even though the actual reactor is being used for classified work and is not now available for general inspection.

Essentially, the reactor is a thermal system using enriched uranium (greater than 90% U^{235}) for fuel. It consists of an assembly of fuel elements, together with control rods, measuring devices, and reflector, submerged in a pool of water that acts as a shield and moderator. A sketch of one arrangement of the reactor and pool is shown in Fig. 1.

The characteristics of the reactor are summarized on the next page. The critical mass is about 3 kg of U^{235} but losses due to beam holes, burn-up and other factors make it necessary to have at least 3.5 kg available. Use of a BeO reflector 10 cm thick on all four sides of the active lattice reduces the critical mass to about 2.4 kg and the lattice dimensions to 9 by 12 by 24 in.

As can be seen by comparison of the flux figures, the design results in a high ratio of fast flux to total flux. In the following sections, the design and construction of the various elements of the reactor are considered.

Fuel Elements

The reactor is designed around the aluminum-uranium alloy fuel elements developed at ORNL. A sketch of one fuel element is shown in Fig. 2. Each element is made up of five fuel plates that consist of uranium-aluminum alloy "sandwiches" clad in aluminum. A fuel plate contains between 30 and 40 gm of U^{235}. Each plate is spaced about ¼ in. from its neighbor.

Experiments show that the plates

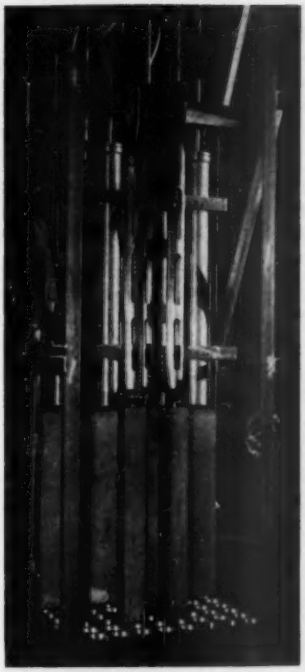

FIG. 3. Partially loaded active lattice of low cost reactor. Control-rod mountings are on top of fuel elements, with cans containing ionization chambers behind them

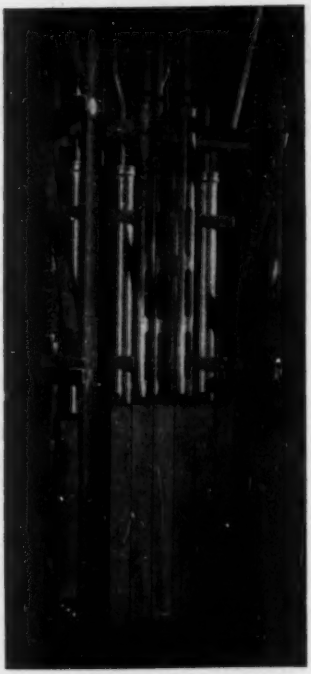

FIG. 4. Completely loaded active lattice of reactor surrounded by beryllium-oxide reflector made up of cold-pressed bricks in dummy fuel elements

CHARACTERISTICS OF LOW-COST REACTOR

Type: Thermal
Fuel: Enriched uranium in aluminum alloy sandwiches
Critical mass: ~ 3 kg U^{235} in 16 fuel elements, 5 plates per element (With BeO reflector, reduced to ~ 2.4 kg U^{235})
Power: 100 kw (nominal)
Maximum available slow-neutron flux: 10^{12} n/cm²/sec
Maximum available epithermal flux: 3×10^{12} n/cm²/sec
Dimensions of active lattice: 12 in. × 12 in. × 24 in. high (9 × 12 × 24 with BeO reflector)
Reflector: Light water or BeO
Moderator: Light water
Cooling: Light water (convective flow)
Control: Boron-carbide absorbing rods actuated by gravity (~ 5% each in Δk)
Shielding: Water plus concrete
Cost—reactor and controls only: < $100,000
Power density in active lattice: 2 watts/cm³ (Light-water reflector)
Heat transfer from fuel plates: 1½ watts/cm² = 5,000 BTU/hr/ft² (Light-water reflector)
Aluminum to water ratio: 0.3

* On leave from The Pennsylvania State College, State College, Pa.

USES OF A RESEARCH REACTOR

Beck (*3*) has previously discussed possible research programs for a low-cost research reactor. It seems worthwhile, however, to point out several studies which the "swimming pool" reactor could be used for.

NEUTRON DIFFRACTION. Collimation of the neutron beam is accomplished with an empty pipe leading through the water to the surface. This beam can be used with velocity selectors to obtain monoenergetic neutrons.

ANALYSIS BY RADIOACTIVATION. Ample flux is present for satisfactory bombardment of samples for chemical analysis.

RADIATION DAMAGE. Relatively few systematic studies have been made, and much remains to be done. Biological studies are also possible.

RADIOISOTOPE PRODUCTION. Fairly intense specific activities can be produced. Investigation of short-life beta and gamma activities resulting from slow-neutron bombardment is of considerable interest at present.

TRACER STUDIES. As an aid in tracer studies, materials can be made radioactive. An example is the study of gear wear (*5*).

FISSION PRODUCTS. Exposing a uranium salt to neutron bombardment makes it possible to obtain fission products for studies of their uses. The AEC is vitally interested in this work (*6*).

retain all of the fission products produced during the life of the element.

These fuel elements can be made at ORNL at a cost of about $120 each, (not including enriched uranium). They should be reprocessed after about 10% burn-up, which corresponds to a total reactor energy output of about two-thirds of a megawatt-year.

The AEC possesses facilities for recovering the fuel from the spent elements, and reprocessing should present no problem to the institution owning the reactor. Also, in case of national emergency, the fuel can be restored to regular production channels in a relatively short time.

Active Lattice

Twelve to sixteen of the elements are placed on end in an aluminum grid to form the active lattice of the reactor. A conical end box is welded to the bottom of each fuel element used in the assembly. These end boxes fit into holes in the aluminum grid. Figure 3 shows the bottom grid and a partial assembly of the core, with guides for the control rods in place above the fuel elements and aluminum cans containing ionization chambers in the background.

The grid contains 54 holes, which are more than are required to support fuel sufficient to make the reactor critical. The extra holes can be used to hold dummy elements containing beryllium oxide reflector or specimens to be irradiated, or to vary the loading pattern.

The design of the fuel elements is based on the requirement that the active lattice dissipates some 100 kw by convection cooling, with a reasonable margin of safety. This and nuclear considerations dictate five plates per element and result in an aluminum-to-water ratio of about 0.3. This is the ratio of the volume of aluminum in the fuel elements including side plates to the volume of water enclosed in the active lattice. The amount of fuel required decreases with the aluminum-to-water ratio, although not in direct proportion.

Reflector

A good reflector placed around the active lattice will reduce the fuel required and improve the flux distribution in the core. It also reduces the available neutron flux external to the reactor.

One method of installing the reflector is to provide a number of aluminum cans of the same outline as a fuel element but filled with cold-pressed beryllium oxide bricks. These can be placed on end in the grid around the active lattice. With 3 in. of beryllium oxide on the four sides of the reactor, the critical mass is reduced by about ¾ kg. Figure 4 is a photograph of the reactor completely loaded, including BeO reflector units.

Advantages of Pool

Submerging the reactor in a pool of water provides a number of advantages. Besides cooling and moderating the reactor, the water supplies a foolproof shield for the operating personnel. Furthermore, should this shield (the water) accidently become contaminated, it can be drained and refilled. With 16½ ft of water above the active lattice, gamma rays are attenuated sufficiently so that a person standing next to the pool will receive considerably less than 50 mr in 8 hours.

The neutron flux is attenuated much more rapidly than the gamma flux in the water. A depth of 3½ ft of water between the reactor and the pool floor and walls will keep the concrete from becoming seriously activated. Thus, if the fuel elements and control rods are removed and the pool drained, personnel can work on the reactor structure after a waiting period of a few hours. This is a feature unique to this particular facility.

Aluminum has a half-life of 2.4 minutes, and, since the reactor structure is made of commercially pure aluminum, the radioactivity decays to a safe level in a relatively short time.

Unless care is taken, the life of the fuel elements may be determined by corrosion. At ORNL it has been found that addition of 50 parts per million by weight of sodium chromate to the ordinary process water used in the pool inhibits corrosion. Other water supplies may require different treatment. If a very low background is necessary, demineralized water must be used, unless the work can be completed in a few hours after a fresh refilling of the pool.

Infinite beam hole. The design of most reactors used for experimental

purposes makes it necessary to use beam holes. These beam holes are awkward devices. The space available in the hole is limited. The holes must be carefully plugged, and even when the reactor is shut down, a shutter must be provided to shield against fission-product radioactivity. Of course, there is no direct access to the active lattice through the beam hole because of this activity.

Immersing the reactor in a pool overcomes a number of these difficulties. The pool in effect provides an infinite beam hole. Large pieces of equipment can be lowered into the water and positioned against the face of the reactor. We have had no trouble since this facility was completed in using instruments and equipment under water, and actually find it much simpler than using a conventional beam hole. Also the procedure is much safer.

However, the design of the swimming pool facility makes optional provision for beam holes for cases where it is desirable to collimate a neutron beam such as is required for experiments in neutron diffraction. A 6-in. beam hole, leading to the active lattice, or an equivalently sized piece of submerged equipment, requires about 3% increase in critical mass of the reactor.

Controls and Safety System

Control is obtained by moving boron-containing rods in or out of the reactor. An iron armature is fastened to the top of each absorbing rod, and the armature and rod are lifted by an electromagnet which also travels in the tubes visible on top of the reactor in Fig. 3. The reactor can be shut down very quickly by reducing the current through the electromagnets so that the rods fall by gravity.

A standard "package" electronic safety and control system has been designed by ORNL personnel and can be supplied by a commercial concern at a price not far from the cost quoted in the tabulation on page 60. These circuits have been in use here for the past two years and have proved to be singularly trouble-free. The system will be described in detail in NUCLEONICS shortly; a brief description follows, and the control panel is shown in Fig. 5.

Start-up is monitored with the aid of a fission chamber, scaler and counter, and counting-rate meter. This circuit covers the range 10^{-4} to 1 watt, and keeps track of the neutron flux level from that due to the source alone with rods down, to a level well above critical.

Above 1 watt, flux is observed with two differential ionization chambers. These instruments contain two chambers, one of which is boron coated. Both respond to gammas, but only the boron-coated one to neutrons. The outputs are connected in opposition and thus, when the compensation is properly adjusted, the net output is a function only of the neutron flux. This means that the chamber will read neutron level even in the presence of a large gamma flux from fission products. It thus allows the reactor to be controlled over a range in powers of nearly 10^6. An ORNL report describing this chamber is forthcoming in the near future.

The output from one of the two differential ionization chambers controls a logarithmic circuit and recorder so adjusted that power levels are read and recorded from 1 watt to 100 kw. The current from the other chamber is measured by a Leeds and Northrup electronic micro-microammeter and, with the aid of shunts, gives a linear indication of the flux level. The output of the micro-microammeter also controls the servomotor which adjusts the reactor flux by raising or lowering a small absorbing rod.

The philosophy of the safety system is that a warning should be given if major circuit trouble develops. In addition, the safety rods must fall if the power is shut off. In line with these ideas, vacuum tubes are used throughout in preference to gas tubes or relays. The amplifiers are monitored continuously at several points, and lights warn the operator if abnormal conditions occur. Each safety circuit is controlled by a 3-in., boron-coated parallel-plate chamber which supplies a current proportional to the neutron plus gamma level. This current flows through a high resistance that is across the input of a preamplifier. The output of the preamplifier supplies a high-level d-c amplifier, and this in turn controls the output of a current amplifier.

This last circuit supplies the exciting

FIG. 5. Control panel of the swimming pool reactor in the Bulk Shielding Facility at Oak Ridge National Laboratory.

COST OF REACTOR AND CONTROLS

Exact costs as of the summer of 1950 were determined from ORNL records. The costs pertinent to the reactor can be broken down as follows.

Fuel elements: 20 at $120 each, exclusive of cost of enriched uranium	$2,400
Reactor assembly: Labor, overhead and materials (motors, magnets, grid, superstructure, etc.)	28,000
Electronic circuits: Labor, overhead and materials (chambers, circuits, recording instruments, etc.)*	28,000
Servo automatic control	2,600
Total: Reactor and Controls	$61,000
In addition, the following equipment is very desirable:	
BeO reflector (30 elements)	17,000
Spares (chambers and electronic equipment)	9,000
Health physics instruments	7,500
Total	$33,500
Grand Total	$94,500

* This complete equipment is now available commercially at approximately this cost. However, the cost will be greater if switchboard mounting, console operation, etc., are desired.

current to the electromagnets which support the safety rods. An increase in chamber current results in a decrease in magnet current, and the amplifiers can be adjusted to drop the magnets at any predetermined flux level within the range of the chambers. Two complete electronic circuits, two chambers, and two rods are supplied. Each rod is worth 5 to 6% in reactivity, depending on the loading.

Safety

This is really a very safe reactor. It has a slight negative temperature coefficient of approximately 0.0075%/° F. This is small, and while it will serve to stabilize the reactor partially, it will take care of less than ½% in reactivity. Safety comes from the fact, which has been demonstrated experimentally, that if the power level rises to more than a few hundred kw, the reactor will boil, and steam will displace sufficient moderator to inhibit runaway. Thus it is not possible to operate the reactor at too high a power level.

Costs

A summary of the costs of this reactor, taken from ORNL records, is tabulated above. The cost of the building and pool will depend on the design, materials, difficulty of excavating, etc. One interesting design involves the location of the facility on the side of a hill. In this way, horizontal beam holes from the reactor can be installed on one side, while the hill forms the shielding on the other three sides of the pool.

Our estimate, based on the cost of a similar structure here, for a pool 14 ft by 18 ft by 22 ft deep, a bay 28 ft by 30 ft high containing the pool and reactor, and 2,500 ft² of laboratory space is $125,000. This makes the bare minimum cost of the reactor, pool, and building a little over $200,000. To these costs must be added the expenses of additional facilities for whatever experimental program is desired.

Higher Power Operation

This reactor can be modified to operate at somewhat higher power levels, but costs will be greater. Among other things, additional shielding and forced-circulation cooling must be supplied.

The bottom of the reactor can be boxed-in and water drawn through the fuel elements by an external pump. Flow through the fuel elements with a Reynolds number sufficient to insure turbulent flow (about 5,000) will provide cooling for 750 kw, with a 15° F rise in the coolant. There is no point in having a much smaller flow than this since laminar conditions will prevail, with a resulting sharp decrease in the heat removal and possible local boiling.

At these high powers and forced circulations, the pump and the line must be shielded because of activity in the water. Radioactive nitrogen, with a half-life of 7 seconds, is formed by the reaction $O^{16}(n,p)N^{16}$. In addition, there is the activity of minerals dissolved in the water. If the pool walls are given a nonsoluble coating and the pool filled with demineralized water, then a flow of cooling water through the reactor of 400 gal/min (possibly with a purge of perhaps 30 gal/min) should afford satisfactory operation at 750 kw. This problem does not arise in the case of convection cooling at lower power because activation is less and the water does not diffuse to the surface rapidly enough.

We do not recommend that this design be operated at power levels of more than a megawatt.

NOTE ADDED IN PROOF: The writer has just learned that the General Electric Co. has been operating a thermal, heterogeneous, oil or water cooled, graphite-moderated research reactor for the past year at power levels up to 100 watts. They consider this model suitable for use in industry, research organizations, and universities for nuclear investigations using thermal neutrons.

* * *

A large number of people from the ORNL staff contributed to the design and construction of the present facility upon which this design is based. The original design was investigated by E. P. Wigner, A. M. Weinberg, M. C. Leverett, H. Soodak, E. Greuling, and others. Critical experiments to confirm the design were carried out by M. M. Mann. The control and safety circuits were proposed by H. W. Newson and P. R. Bell, and designed and built by W. H. Jordan, T. E. Cole, J. E. Owens, E. P. Epler, and others. The design upon which this report is largely based was developed by W. R. Gall, who was aided by operational investigations made by S. E. Beall. ORNL is operated for AEC by Union Carbide and Carbon Corp.

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Radiation Characteristics of High-Energy Electron Accelerator Targets

Spectral and angular distributions of the radiation for incident electrons above 5 Mev are given for a useful range of target thicknesses. Radiation characteristics for targets outside this range are described qualitatively

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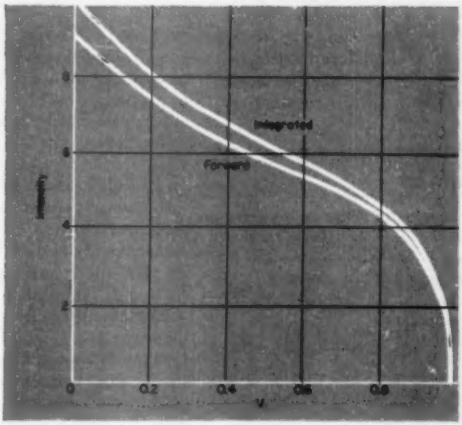

FIG. 1. Forward and integrated intensity spectra for $U = 24.5$ and $Z = 78$

THE CHARACTERISTICS of the target radiation from high-energy electron accelerators can be divided conveniently into four categories according to the thickness of the target expressed in radiation lengths.

In the first of these categories (corresponding to extremely thin targets) the intrinsic angle-energy distribution of the radiation alone is important. For slightly thicker targets, this distribution is modified in a complicated way by the elastic scattering of the electrons.

For even thicker targets, the scattering is the predominant factor in determining the angular distribution of the radiation, and the radiation characteristics can be expressed in convenient analytical form (this thickness range is probably of most practical importance). Finally, for very thick targets, ionization loss, electron straggling, and self absorption in the target become important and calculations again become difficult.

In this paper, an attempt is made to present as simply as possible the essential features of the target radiation. Formulas for the fundamental processes are quoted, and the combined effect of these processes in determining the radiation characteristics is calculated where this may be readily done, or discussed qualitatively where no general formulation is possible. Ap-

Symbols Used

U = total electron energy
$\mu = 0.51$ Mev = electron rest energy
vU = energy of radiated quantum; v lies between 0 and $1 - \mu/U$
θ = angle with forward direction
Z = atomic number
A = atomic weight
$N = 6.02 \times 10^{23}$ = Avogadro's number
r_0 = classical electron radius $= 2.82 \times 10^{-13}$ cm
$\sigma(vU,\theta)Udvd\theta$ = cross section for emission of quantum with energy between vU and $(v + dv)U$, at angle between θ and $\theta + d\theta$
t = target thickness in radiation lengths
$R(\theta)$ = fraction of electron energy radiated per unit solid angle in direction θ
τdt = fraction of energy radiated in thickness dt radiation lengths
$\gamma = 1.78$ = Euler's constant

TABLE 1—Radiation Lengths of Common Elements

Element	*Radiation length* (gm/cm^2)
Hydrogen	138
Carbon	52
Nitrogen	45
Oxygen	39.7
Aluminum	26.3
Iron	14.4
Copper	13.3
Lead	5.9

proximate methods have been used in those instances where the reduction in complexity justifies the sacrifice of accuracy, although references are made to more accurate treatments where these exist.

Only brief references are made to experimental studies, since these have tended to verify the theory, and there is no instance where the theoretical results given in this paper could profitably be modified in the light of experimental results obtained up to the present.

A table is given at the end of the paper in which a summary of the formulas to be used in the various thickness ranges is given.

"Infinitely Thin" Target

The spectral distribution of the radiation emitted by a high-energy electron deflected by the electric field of the atomic nucleus was first calculated by Bethe and Heitler (*1*). This calculation was based on the Thomas-Fermi model of the atom, and used the Born approximation. Formulas in suitable form for computation based on this theory were later given by Rossi and Greisen (*2*).

More recently, an expression giving the dependence of this spectrum on the angle of emission of the quanta has been given by Schiff (*3*). This formula is based on a simplified atomic model, and has been adjusted empirically to agree with the calculation based on the Thomas-Fermi model for the cases of complete screening and of no screening. Schiff also gives an expression for the spectral distribution of the radiation integrated over all angles; this is directly comparable with the formulas given by Rossi and Greisen, but is rather simpler because of the simplified atomic model which is used.

Throughout this paper the kinetic energy of the electrons incident on the target will be assumed large compared with their rest energy, and since under this condition the radiation travels predominantly forward it is possible to use the small angle approximation, $\sin\theta \approx \theta$. Integration over all angles will be taken for analytical convenience between $\theta = 0$ and $\theta = \infty$. The notation follows as closely as possible that of Rossi and Greisen.

With this notation the formulas given by Schiff may be written

$$\sigma(vU,\theta)Udvd\theta = \frac{4Z^2r_0^2}{137}\frac{dv}{v}\theta d\theta \times \left\{\frac{\mu^4}{(\mu^2 + U^2\theta^2)^2}[(v^2 - 2v + 2)\ln M(\theta) - (2 - v)^2] + \frac{\mu^6U^2\theta^2}{(\mu^2 + U^2\theta^2)^4} \times [(1 - v)(16 - 4\ln M(\theta))]\right\} \quad (1)$$

where

$$\frac{1}{M(\theta)} = \left[\frac{\mu v}{2U(1 - v)}\right]^2 + \left[\frac{\mu^2 Z^{1/3}}{111(\mu^2 + U^2\theta^2)}\right]^2$$

It will be seen that the spectrum is not strongly dependent on angle, especially when v is large. Integration over all angles gives

$$Ud\nu\int_0^\infty \sigma(vU,\theta)d\theta = \frac{2Z^2r_0^2}{137}\frac{dv}{v}\left\{\left(\frac{4}{3} - \frac{4}{3}v + v^2\right)\times\left(1 + \ln M(0) - \frac{2}{b}\tan^{-1}b\right) + (1 - v)\left[\frac{2}{b^2}\ln(1 + b^2) + \frac{4}{3b^2}(2 - b^2)\tan^{-1}b - \frac{8}{3b^2} + \frac{2}{9}\right]\right\} \quad (2)$$

where $b = 2U(1 - v)Z^{1/3}/111v\mu$.

Equation 2 may be compared with the curves given by Heitler and by Rossi and Greisen, but it will be found not to differ significantly from them. An estimate of the difference under various conditions is given by Schiff, who states that it should never exceed 4% in the worst case of Z large and screening incomplete.

In Fig. 1 a comparison is made, for $U = 24.5$ Mev, of the integrated and forward spectra (the forward spectrum is obtained by setting $\theta = 0$ in Eq. 1). Only the quantities inside the curly brackets are plotted, so that the ordinates are proportional to radiation intensity rather than the number of quanta. A calculation of the forward spectrum using the formula of Rossi and Greisen was also made and compared with that given by Schiff's formula. The greatest discrepancy was 4%, and it occurred where $v = 0.7$.

The shape of the spectral distribution has been satisfactorily verified at 300 Mev (*4, 5*). At lower energies (*6–8*) the statistical accuracy of the experiments is not so good, although there is definite evidence that at 20 Mev there are relatively more quanta than are predicted by the theory for values of v equal to about 0.6.

If Eq. 2 is multiplied by v and integrated with respect to v, the total cross section for energy loss by radiation is obtained. The result of this integration cannot in general be expressed in simple analytical form, but the appropriate numerical integration over a range of energies for several materials has been performed by Heitler. For the limiting case of very high energies, the integral can be evaluated quite simply as

$$\left(\int_0^{1-\mu/U}\int_0^{\infty}\sigma(vU,\theta)d\theta dv\right)_{U\to\infty} = \frac{4Z^2r_0^2}{137U}\left(\ln 183Z^{-\frac{1}{3}}+\frac{1}{18}\right) \quad (3)$$

On the basis of this result, the very useful unit of thickness known as the "radiation length" is defined. One radiation length, X, of a material of atomic weight A is

$$X = 137A/(4Z^2r_0^2N\ln 183Z^{-\frac{1}{3}}) \quad \text{gm/cm}^2$$

Values of X for some common substances are given in Table 1. This unit will be used exclusively in measuring the thickness of targets. The rate of loss of energy by radiation, per radiation length, is approximately equal to the energy of the electron ($dU/dt \approx U$). If it were not for the small term $\frac{1}{18}$ this would be accurately true at high energies.

Curves showing the loss of energy by radiation, per radiation length, are shown in Fig. 2. These are obtained from the curves of total cross section for radiation given by Heitler by multiplying them by a suitable function of Z. Curves showing the rate of energy loss by ionization are also plotted for comparison.

Moderately Thick Targets

If the target has a small but finite thickness, both the spectral distribution of the radiation in the forward direction and its angular distribution are modified by the elastic scattering of the electrons in the target. Rossi and Greisen (*2*) have shown that the root-mean-squared angle of scattering of the electrons after passing through a thickness t of the target is approximately $(440t)^{\frac{1}{2}}/U$, and that for t not too small and θ not too large, the normalized distribution of electrons per unit solid angle is given by

$$F(t,\theta) = \frac{U^2}{440\pi t}e^{-U^2\theta^2/440t} \quad (4)$$

Elastic scattering will be important unless the root-mean-squared angle of scattering is much less than the characteristic angle of the intrinsic angular distribution of Eq. 1. The characteristic angle of the distribution may be defined as μ/U, and is of the same order as the mean angle. The root-mean-squared angle cannot conveniently be defined since it diverges in the approximation used in Eq. 1.

The condition that elastic scattering is unimportant then becomes $\mu/U \gg (440t)^{\frac{1}{2}}/U$, or $\mu^2 \gg 440t$; numerically this becomes $t \ll 5\times10^{-4}$ radiation lengths. If, however, μ^2 is of the same order as $440t$, the problem of finding the angle-energy distribution and forward intensity is very difficult and will not be attempted here. The scattering has the effect of widening the angular distribution and smearing out the angular variation of the spectrum, so that the forward spectrum is intermediate in shape between $\sigma(vU,0)$ and $\int_0^{\infty}\sigma(vU,\theta)d\theta$.

For somewhat thicker targets, where the root-mean-squared angle of the scattering is large compared with μ/U, so that $440t \gg \mu^2$, it is fortunately possible to find expressions for the forward intensity and angular distribution, and under these conditions the forward spectrum will be given very closely by the integrated spectrum of Eq. 2.

The calculations in this paper will be based on the simplified scattering theory of Rossi and Greisen rather than the more accurate theories such as those of Molière (*9*) and Snyder and Scott (*10*). This is necessary to keep the analysis simple. The forward intensity will be calculated first.

The fraction of the electron energy that appears as radiation per unit solid angle in the forward direction is

$$R(0) = \tau\int_0^t\int_0^{\infty}\int_0^{1-\mu/U}\times \sigma(vU,\theta)F(t,\theta)dvd\theta dt\Big/\int_0^{\infty}\int_0^{1-\mu/U}\times \sigma(vU,\theta)dvd\theta \quad (5)$$

where τ is given in Fig. 2, $\sigma(vU,\theta)$ by Eq. 1, and $F(t,\theta)$ by Eq. 4. Substituting for $F(t,\theta)$, and integrating from 0 to t

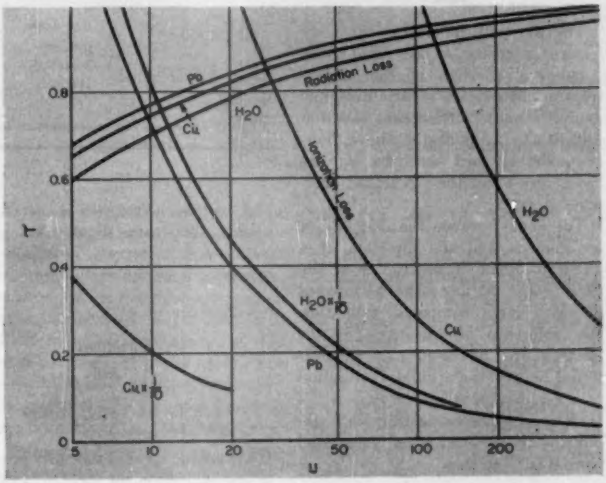

FIG. 2. Fractional loss of energy by radiation and ionization per radiation length

$$R(0) = -\frac{U^2\tau}{440\pi}\int_0^{\infty}\int_0^{1-\mu/U}\sigma(vU,\theta)\times \mathrm{Ei}\left(\frac{-U^2\theta^2}{440t}\right)dvd\theta\Big/\int_0^{\infty}\int_0^{1-\mu/U}\times \sigma(vU,\theta)dvd\theta \quad (6)$$

Now, since $U^2/440t \ll U^2/\mu^2$, and $\sigma(vU,\theta)$ is small when $\theta \gg \mu/U$, the quantity $U^2\theta^2/440t$ will be small for values of θ for which $\sigma(vU,\theta)$ is not small, so that $-\mathrm{Ei}(-U^2\theta^2/440t)$ may be replaced by the small-angle approximation $-\ln(\gamma U^2\theta^2/440t)$. A little rearrangement leads to

$$R(0) = \frac{U^2\tau}{440\pi}\left(\ln\frac{440t}{\gamma\mu^2} - \int_0^{\infty}\int_0^{1-\mu/U}\sigma(vU,\theta)\ln(U^2\theta^2/\mu^2)\times dvd\theta\Big/\int_0^{\infty}\int_0^{1-\mu/U}\sigma(vU,\theta)dvd\theta\right) \quad (7)$$

Now it is a remarkable and convenient fact that if the slight depend-

ence of the $M(\theta)$ of Eq. 1 on θ is neglected, and Eq. 1 substituted into Eq. 7, the second term in the bracket vanishes. This may be seen at once when it is realized that

$$\int_0^\infty x^{2n-1}(1+x^2)^{-2n} \ln x \, dx = 0$$

where n is a positive integer, and x represents $U\theta/\mu$. Substitution for γ and μ in Eq. 7 results in

$$R(0) = \frac{U^2\tau}{440\pi} \ln 950t \qquad (8)$$

The complete independence of the forward intensity on the difference in angular distribution of the various spectral components is fortuitous, and appears because of the assumption that $440t \gg \mu^2$. As indicated above, however, the forward spectrum is very nearly given by the integrated spectrum of Eq. 2.

The angle between the direction of an electron and the direction of a quantum which it radiates is of the order μ/U. At angles to the forward direction large compared with this, the difference of directions of the electron and quantum may be neglected, so that the angular distribution of the radiation is simply that of the total distribution of electrons throughout the target—i.e., $F(t,\theta)$ integrated from 0 to t—so that

$$R(\theta \gg \mu/U) = -\frac{\tau U^2}{440\pi} \mathrm{Ei}(-U^2\theta^2/440t) \qquad (9)$$

This is not true for small θ, but an empirical adjustment which removes the divergence and gives the correct value of $R(0)$ has been suggested by Muirhead, Spicer and Lichtblau (*11*). This is

$$R(\theta) = \frac{\tau U^2}{440\pi}[-\mathrm{Ei}(-U^2\theta^2/440t) + \mathrm{Ei}(-U^2\theta^2/\gamma\mu^2)] \qquad (10)$$

The above analysis is essentially a slight extension of that indicated by Schiff (*12*), except that Rossi and Greisen's scattering theory is used rather than that of Williams (*13*). Nevertheless, these theories are not very different, and curves plotted from the above formula are indistinguishable in shape from those given by Schiff. Curves of $R(\theta)$ for $t = 0.005$, 0.02 and 0.1 are shown in Fig. 3.

The logarithmic form of $R(0)$ (Eq. 8) indicates that most of the radiation comes from the front part of the target.

Summary of Calculation Methods

Target thickness (gm/cm²)	*Forward spectrum*	*Forward intensity*	*Angular distribution*	*Important characteristics*	*Applications*
$\ll 5 \times 10^{-4}$	Eq. 1 with $\theta = 0$	Eq. 12	Eq. 1	$\mu^2 \gg 440t$, scattering not important	
< 0.005		Eq. 5		$\mu^2 \sim 440t$, scattering important	
0.005–0.1*	Eq. 2	Eq. 8	Eq. 10	$\mu^2 \ll 440t$, Gaussian multiple scattering	Betatrons and synchrotrons
> 0.1*		For example, see Lanzl and Hanson (*17*)		Scattering, straggling, ionization loss, and self absorption	Linear accelerator when ionizing radiation rather than pure spectrum is required

* May be less at low energies with low-Z targets where ionization loss is important.

The expression for $R(0)$ is inaccurate when t is less than about 0.005. But for very thin targets in which the scattering is negligible

$$R(0)_{(\mu^2 \gg 440t)} = \frac{\tau t \int_0^{1-\mu/U} \left[\frac{\sigma(vU,\theta)}{2\pi\theta}\right]_{\theta=0} dv}{\int_0^\infty \int_0^{1-\mu/U} \sigma(vU,\theta) dv d\theta} \qquad (11)$$

If the second term in the curly bracket in the expression for $\sigma(vU,\theta)$, and the dependence of M on θ are neglected, Eq. 11 simplifies to

$$R(0)_{(\mu^2 \gg 440t)} = \tau t U^2/\pi\mu^2 \qquad (12)$$

which should be a fairly good approximation. The expressions for $R(0)$ with t large and t small are shown in Fig. 4. Neither expression is valid when $440t$ is of the same order as μ^2.

An alternative method of analysis in which the dependence of $\sigma(vU,\theta)$ on θ is assumed to be Gaussian has been used by Lawson (*14*) and by Kulenkampff, Scheer and Schittenhelm (*15*). This has the advantage of giving a single formula valid for all values of t and θ, but the accuracy is less than that of the treatment given here, and the effect of the simplifying assumption is not so easy to see. The methods are compared by Lawson (*16*).

Lanzl and Hanson (*17*) have extended this method in a more accurate treatment in which the scattering theory of Molière is used. They find that the beam width of the radiation as given by Eq. 10 is rather too wide for heavy elements, and that the radiation at large angles is underestimated. Both of these effects they observe experimentally in good agreement with theory. While their work is of considerable interest in verifying the fundamental radiation and scattering theories, their formula for the angular distribution is more complicated than Eq. 10. Other workers, on the other hand (*11*), find better agreement when the scattering theory of Williams (*13*) is used.

Equations 8 and 10 should be reasonably accurate at energies above 5 Mev for values of t between 0.005 and 0.1. At the upper end of this range however, ionization loss will reduce the forward intensity slightly at low energies for low-Z targets and will distort the spectral distribution. There will also be a slight reduction of intensity due to the absorption of radiation in the target. Whether these effects are important depends on the use to which the machine is being put. They can, however, be readily calculated so long as they are small.

The above range of target thickness corresponds roughly to the range that can successfully be used in betatrons and synchrotrons. If very thin targets are placed in these machines, multiple transits occur, and those electrons which pass through the target once have a high probability of striking it a second time at an angle to their original direction, so that the radiation beam is broadened. If very thick targets are used, on the other hand, the electrons strike the edge of the target

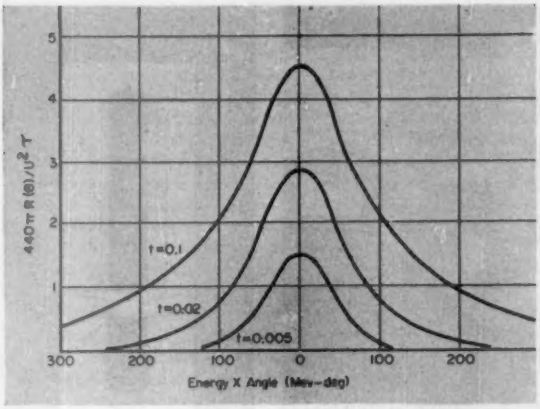

FIG. 3. Angular distribution of radiation for various target thicknesses

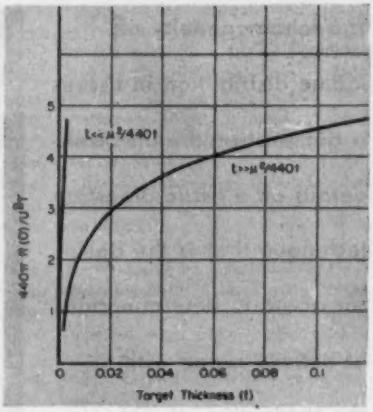

FIG. 4. Forward intensity as function of target thickness

first, and are scattered out of the side before passing right through; this results in a narrower and unsymmetrical beam. Both these effects have been demonstrated experimentally (*14*), but their importance depends on accelerator characteristics.

Very Thick Targets

Much more flexibility is possible when designing targets for linear accelerators. Very thin and very thick targets may both be successfully used. Targets of thickness sufficient for the incoming electrons to be completely stopped are important in some applications, but the calculation of the radiation characteristic of such targets would be a laborious process requiring numerical methods, and the results would only be valid for a particular energy and target material.

At low energies, loss of energy by ionization may become important. Curves showing the rate of energy loss of fast electrons as a function of energy, computed from Bloch's formula as given by Rossi and Greisen (*2*), are shown in Fig. 2. The effect of ionization loss is to reduce the energy of the electrons equally through the target so that the electron energy is a function of depth. If this were the only "thick target" effect of importance (as it might be at low energies for targets with Z small and t about 0.1 radiation lengths) spectra from the various layers of the target could be added, the weight attached to the different layers being given by the slope of the curve in Fig. 4. The effect would be greatest on the extreme high-energy tip of the spectrum.

Straggling is a much more difficult phenomenon to estimate accurately. The electrons are monochromatic when they strike the front face of the target, but as they proceed through it the energy distribution is degraded because the electrons lose energy by radiation. A simplified theory giving the general features of the effect has been given by Bethe and Heitler (*1*), but, in general, calculations are difficult.

The effect of straggling on the forward spectrum should be negligible in targets up to about 0.15 radiation lengths thick, but there would probably be a significant difference in the spectrum at large angles to the axis. In contrast to ionization, which affects only the tip of the spectrum, straggling gives a general reduction at the high-energy end and an increase at the lower-energy end of the spectrum.

Of more importance in the forward direction is the absorption and scattering of the radiation in the target itself. This is difficult to calculate accurately, but a reasonable estimate may be made if it is assumed that all the forward radiation is produced at the front edge of the target, and that the target merely acts as an absorber. The formula for the forward intensity is logarithmic in form, and is very insensitive to target thickness so long as $440t \gg \mu^2$. In a very thick target, an underestimate of the forward intensity (neglecting for the moment self absorption) will be given by putting $t = 0.1$, and an overestimate by putting $t = 1$; these two estimates are in the ratio 2:3, so that $R(0)$ can easily be obtained within about 20%. Such an estimate has been verified at 7.3 Mev (*18*). The intensity and spectral distribution at large angles to the axis are difficult to predict however.

An example of a calculation of forward intensity for a particular case of a thick target which agrees well with experiment is given by Lanzl and Hanson (*17*). The forward intensity increases with thickness until the rate of absorption of the radiation becomes as great as its rate of production, after which the intensity decreases in an approximately exponential fashion.

* * *

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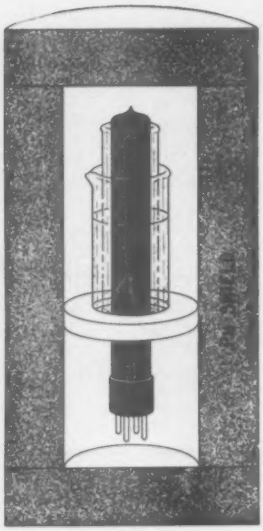
The inhomogeneity of iodine distribution in tissues is demonstrated along with details on a tissue-digestion technique that is the basis for accurate determinations of activity range with the Marinelli method for counting liquid samples



MARINELLI COUNTER is contained in lead shield at left. Sample holder, such as one in foreground, is inserted from above. Diagram indicates relation of holder to vertically mounted bismuth-wall G-M counter inside shield

Preparation of Tissues for Iodine-131 Counting

By JESSE D. PERKINSON, JR.,* and H. D. BRUNER†
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AN EXAMINATION of past and current literature reveals the fact that there are wide variations in counting methods as well as in methods used in preparing tissues for determination of iodine-131 activity. While individual situations determine the use of a particular technique, the choice of any method must be based on the degree of quantitation required as well as the speed desired. The speed, in turn, is a function of

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I^{131} Activity Measurements for Tissues of Six Dogs‡

	Activity Range for Four Portions of Same Sample			
Dog	*Muscle (cpm/gm)*	*Heart (cpm/gm)*	*Liver (cpm/gm)*	*Thyroid (cpm/gm) × 10^3*
1	5–80	15–27	10–42	5.6–10.3
2	9–84	8–65	18–39	9.2–15.9
3	5–14	4–17	7–16	6.1– 9.9
4	7–54	8–99	21–30	5.1– 6.9
5	15–96	17–42	18–34	10.0–12.1
6	10–23	21–53	29–41	12.6–16.3

‡ Animals sacrificed 48 hours after injection of 20 μc I^{131} per kg.

equipment, space, personnel available, and the number of samples.

For measuring I^{131} activity in tissues, an accurate counting method must be chosen that is compatible with the particular method of sample preparation.

Liquid sample counting has the following advantages: (1) Only a one-step preparation (digestion) of the tissue sample is involved; (2) the possible error in taking a representative micro sample from a large initial volume is overcome; (3) no volatilization of the iodine occurs (as might during ashing or drying of an aliquot on a planchet); (4) constant geometry is more simply achieved with a liquid than a solid; and (5) since gamma rays are counted, there is no self-absorption problem.

If a liquid counting system is used, a suitable method for tissue digestion must be selected. In making this choice, the chemical properties of iodine should be considered. Any tissue digestion procedure should be based on the fact that iodine may be quite volatile. Since iodine oxidation occurs in an acid solution, the iodine-containing tissue digest should be kept alkaline, and high temperatures should be avoided.

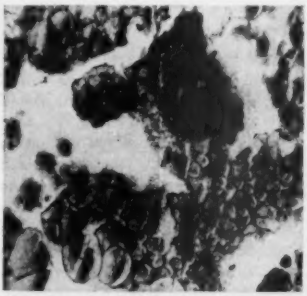
The counting apparatus used in these studies was essentially that described by Marinelli and Hill (*1*). In this counting chamber, the brass jacket surrounding the tube was omitted and a bismuth-wall tube was used instead of the conventional silver-wall G-M one. See the photograph and diagram of this apparatus above. As has been shown by Bradt *et al.* (*2*), such a bismuth tube has an I^{131} gamma sensitivity about five times greater than that of a copper cathode tube. With 40 ml of I^{131} solution in double-wall beakers (4-mm-thick liquid column), sensitivity was about 4,000 cpm/μc.

Tissue Digestion Studies

Approximately 20 μc of I^{131} per kg were injected into a saphenous vein of mongrel dogs weighing from 5 to 7 kg. The dogs were sacrificed, by intravenous ether injection, 48 hours after iodine administration. Immediately after death, both lobes of the thyroid and samples of the liver, heart, and sternohyoid and sternothyroid muscles were removed.

Each tissue sample was finely minced and thoroughly mixed. Weighed portions of these samples were placed in 50-ml graduated centrifuge tubes. One of the following reagents was added to each tube so that portions of the same sample of each tissue or organ were subjected to five different digestion procedures: (1) 2*N* NaOH, (2) approximately 100 mg of papain, (3) approximately 100 mg of ficin, (4) 2*N* NaOH with 0.1 ml of 0.5*M* NaI and 0.1 ml of 0.5*M* $NaHSO_3$, and (5) 2*N* NaOH after the tissues were homogenized in a glass system. The final volume in each case was 20 ml.

The tissue samples thus treated were incubated over night at 70° C to obtain maximum papain and ficin activity. Cotton plugs used to stopper the tubes had no measurable activity at the end of the incubation; thus it was evident that none, or a negligible amount, of the iodine was volatilized from the samples. The digests were transferred to the Marinelli counting tubes and their activities determined.



ENLARGED AUTORADIOGRAPH of section of dog thyroid containing I^{131} shows variation of concentration of the radioactive material in different parts of the tissue

In preliminary studies based on 100 determinations made of the I^{131} activity in tissues from five dogs, it was seen that the highest activity per gram of tissue was found when the minced samples were treated with NaOH, NaI, and $NaHSO_3$, as in procedure 4. This treatment was considered to be the best of those studied.

Reproducibility of Method

To determine the degree of reproducibility of the method, four portions of the same minced tissue samples were digested with NaOH in the presence of NaI and $NaHSO_3$. The results obtained from the study of tissues from six additional dogs are shown in the table above. At this level of activity, it is doubtful that any differences in the values found in skeletal muscle, heart, or liver are significant, but the thyroid values varied to a highly significant degree. The differences here are striking when the lowest and highest concentrations found in mixed, minced samples of whole thyroid from the same dog are compared.

An examination of the autoradiograph above may help in understanding the lack of consistency found. It is true that the density of the autoradiographs cannot be quantitated, but it is also obvious that some parts of the thyroid contained more I^{131} activity than did other parts. When such a tissue is minced and pieces of it are taken for analysis, it is possible that one sample may contain pieces of more intense activity than another sample. Thus values obtained from such a sampling procedure would be different. This inhomogeneity of iodine distribution has been noted by Evans (*3*) and others.

Discussion

The differences found in recovered activity in portions of the same thyroid gland treated in the same manner become important in the interpretation of data obtained when the activity of only a part of the thyroid gland is determined. These results indicate that when a biopsy or autopsy sample is taken and its I^{131} activity is determined, one should not extrapolate these results to indicate the exact concentration in any other part of the organ. In making measurements of I^{131} concentration in tissues of smaller animals, as in metabolism studies, the inhomogeneity problem is less important since usually the activity of an organ is determined *in toto*, but with human thyroid tissue such a procedure is hardly possible.

It seems that the only solution lies in the awareness that the I^{131} activity in one part of a tissue need not, and probably does not, reflect the concentration in an adjacent section of the same tissue.

* * *

The authors wish to thank Mr. John Gallimore and Mr. George Boyd for the preparation and interpretation of the autoradiograph.

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Applications of Pile-Kinetic Equations

Step changes in reactivity, which may occur in operation of a reactor, result in flux transients. A method of analytical solution for the thermal-flux transients that follow step changes in graphite-uranium reactors is given

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Minneapolis, Minnesota

THE TIME DEPENDENT behavior of nuclear reactors presents unique problems of control and instrumentation. Fortunately, the phenomenon of delayed-neutron emission simplifies the engineering features, since a slower response time is developed than when there are no delayed neutrons.

For example, with a typical uranium-graphite reactor, a step increase in reactivity of 0.3% would produce, after 1 sec, a 20-fold increase in the power if there are no delayed neutrons. If there are delayed neutrons, the increase would be by a factor of 1.9.

However, in the application of nuclear reactor theory, the effects of the delayed neutrons lead to considerable mathematical complications. The applications of the resulting pile-kinetic relations are tedious even for elementary cases.

Several excellent discussions of the general nature of pile kinetics and associated problems in reactor control and instrumentation have been published (*1–8*). This article serves to illustrate the method of obtaining analytical solutions of the pile-kinetic equations for cases which can be applied to graphite-uranium piles such as the Argonne, Oak Ridge, Brookhaven, Hanford, and British reactors (*9*). Although such applications have already been made, they have not been declassified in sufficient detail to be applied readily (*4, 7*).

The problem considered is that of the step change in reactivity which produces a transient in the reactor power or thermal flux. The solutions presented are limited to those cases that do not involve an extraneous thermal-neutron source and for which the spatial distributions are preserved.

The relative thermal flux (at a given spatial position) as a function of time, measured from the instant of the step change in reactivity, can be represented as a series solution of the time-dependent equations.

A procedure is outlined for obtaining the coefficients and exponents of this series solution. The power output of a thermal reactor would be directly proportional to the thermal flux. Figures 1–7, which illustrate the coefficients and exponents for positive step changes in reactivity, simplify the application of the pile-kinetic relations for cases involving typical graphite-uranium piles.

Frequently an attempt is made to simplify the evaluations of the flux transients by employing a "two-term" method in which one term represents the effects of prompt neutrons and the second term the effect of the delayed neutrons. Actually the two-term method may be misleading, and a comparison with the analytical solution is given in Fig. 8.

If a large number of evaluations must be made, then use of a pile-kinetic simulator such as that described by Pagels (*10*) is well justified. Typical results of such a simulator are also shown in Fig. 8.

Time-Dependent Equations

The time dependence of the thermal-neutron flux, without an extraneous source, may be represented by the first-order differential equations (*2*)

Accumulation		*Disappearance*		*Generation*	
$\frac{dc_i}{dt}$	$=$	$-\lambda_i c_i$	$+$	$u_i\phi$	(1)

$$\frac{d\phi}{dt} = -r\phi + w\phi + x\sum_{i=1}^{6}\lambda_i c_i \qquad (2)$$

(*Prompt*) (*Delayed*)

The conditions at $t = 0$ are defined as

$$\phi = \phi_0; \qquad \frac{dc_i}{dt} = 0; \qquad c_i = c_{i0}$$

The following definitions of terms have been used in Eqs. 1 and 2

$$u_i = \frac{\Sigma_a k}{p}\beta_i; \qquad r = \frac{F}{l_0}$$

$$w = \frac{(1-\beta)kP}{l_0}; \qquad x = \frac{pP}{l_0\Sigma_a}$$

Equations 1 and 2 are "input minus

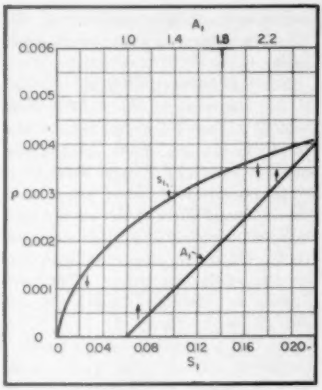

FIG. 1. Coefficient and exponent for prompt-neutron fraction of thermal-flux transient as function of step change in reactivity

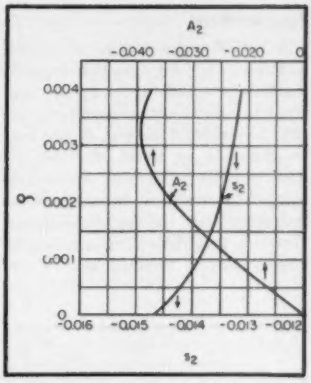

FIG. 2. Coefficient and exponent for first delayed-neutron fraction of thermal-flux transient as function of step change in reactivity

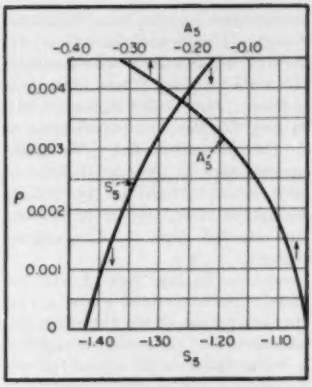

FIG. 5. Coefficient and exponent for fourth delayed-neutron fraction of thermal-flux transient as function of step change in reactivity

Symbols Used

- c_i = concentration of ith group of delayed-neutron emitters
- λ_i = decay constant of ith group
- $t_{i\frac{1}{2}}$ = half-life of ith group
- ϕ = thermal-neutron flux (time dependence only)
- ϕ_0 = thermal-neutron flux at $t = 0$
- Σ_a = macroscopic absorption cross section of reactor materials
- p = resonance escape probability
- β_i = fraction of fission neutrons which are in ith group of delayed neutrons
- β = total fraction of fission neutrons which are delayed = $\sum_{i=1}^{6} \beta_i$
- l_0 = mean lifetime of thermal neutron in infinite reactor = $1/v\Sigma_a$
- l = mean effective life of thermal neutron in finite reactor = l_0F
- l' = modified effective lifetime of thermal neutron in finite reactor = l/k_{eff}
- v = thermal-neutron velocity
- F = fraction of thermal neutrons which do not leak from reactor
- k_{eff} = thermal-neutron multiplication constant for finite reactor = kPF
- k = thermal-neutron multiplication constant for infinite reactor
- P = fraction of fast neutrons which do not leak from reactor
- ρ = reactivity = $(k_{eff} - 1)/k_{eff}$
- Λ = reactor period, $d\ln\phi/dt = 1/\Lambda$. For prompt neutrons only, $\Lambda = l/(k_{eff} - 1) = l'/\rho$

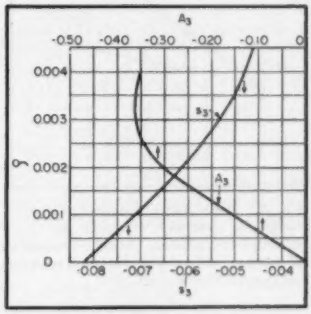

FIG. 3. Coefficient and exponent for second delayed-neutron fraction of thermal-flux transient as function of step change in reactivity

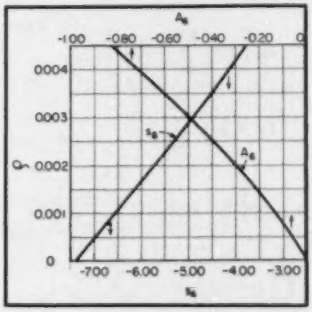

FIG. 6. Coefficient and exponent for fifth delayed-neutron fraction of thermal-flux transient as function of step change in reactivity

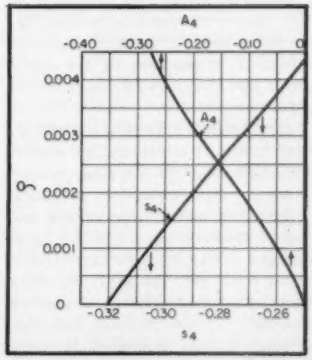

FIG. 4. Coefficient and exponent for third delayed-neutron fraction of thermal-flux transient as function of step change in reactivity

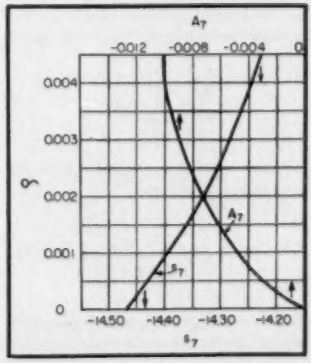

FIG. 7. Coefficient and exponent for sixth delayed-neutron fraction of thermal-flux transient as function of step change in reactivity

output equals accumulation" balances. Equation 1 represents the balance for the time dependence of the concentration of the ith group of delayed-neutron emitters. Equation 2 represents the balance for the time dependence of the thermal-neutron flux. No significant changes in the spatial distributions would be expected for uniform changes in reactivity, or for regions far removed from local reactivity changes.

Solutions for Eqs. 1 and 2, with the initial conditions stated above, can be obtained by use of the Laplace transformations with the transform variable, s, being taken with respect to the time measured from the step change in reactivity (*11*). Let the Laplace transform of the flux be $L\{\phi\} = y$, and that of the concentration be $L\{c_i\} = z_i$. Application of the transforms to Eqs. 1 and 2, and elimination of z_i yields

$$y = \frac{\phi_0\left[l' + \sum_{i=1}^{6}\frac{\beta_i}{s+\lambda_i}\right]}{l's - \rho + \sum_{i=1}^{6}\frac{\beta_i}{s+\lambda_i}} = \frac{\phi_0\prod_{i=1}^{6}(s+\lambda_i)\left[l' + \sum_{i=1}^{6}\frac{\beta_i}{s+\lambda_i}\right]}{\prod_{i=1}^{6}(s+\lambda_i)\left[l's - \rho + \sum_{i=1}^{6}\frac{\beta_i s}{s+\lambda_i}\right]} = \frac{g(s)}{h(s)} \tag{3}$$

This equation defines the functions $g(s)$ and $h(s)$. The series solution of the time-dependent equation is given by the general solution of the inverse Laplace transform, $L^{-1}\{y\} = \phi$, and is

$$\frac{\phi}{\phi_0} = \sum_{j=1}^{7} A_j e^{s_j t} \tag{4}$$

Values for s_j are obtained from the roots of the equation

$$l's - \rho + \sum_{i=1}^{6}\frac{\beta_i s}{s+\lambda_i} = 0 \tag{5}$$

and the coefficients A_j are obtained for each of the seven roots from the ratio

$$A_j = \left[\frac{g(s)}{\frac{dh(s)}{ds}}\right]_{s_j} \tag{6}$$

Applications

A typical mean lifetime of thermal neutrons, l_0, for graphite-uranium reactors is about 10^{-3} sec; for large reactors close to critical conditions, the modified effective lifetime, l', also may be taken to be about 10^{-3} sec (*1*). This value is suitable for approximation of the transient behavior of the Argonne, Oak Ridge, Brookhaven, Hanford, and British reactors, which employ natural uranium as fuel and graphite as moderator. [Other suggested values are 1.25×10^{-3} and 1.5×10^{-3} sec (*6*, *12*).]

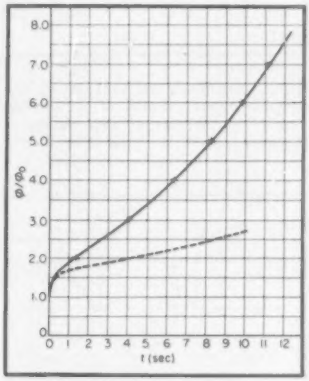

FIG. 6. Thermal-flux transient for step change in reactivity of 0.003 by three methods of calculation. Solid line: analytical solution; dotted line: two-term method; and crosses: kinetic simulator

The decay constants and yields of the delayed neutrons are summarized in the table. With these data, the numerical evaluations of the coefficients and exponents of Eq. 4 can be made.

Changes in pile reactivity arise from such factors as control-rod movement, fuel depletion, fuel charging and discharging, fission-product poisoning, temperature and pressure effects, and special irradiations. In starting up or shutting down a reactor, or in changing power levels, step changes in reactivity may occur through changes in position or pattern of control rods, and even through changes in coolant temperature or pressure of the ambient gas. Problems of controlling a power level are more closely allied with continuous changes in pile reactivity and such examples have been presented (*5*, *6*). The details for a step change are given here.

For positive step changes in reactivity, the roots of Eq. 5 have been plotted in Figs. 1–7 as functions of the reactivity change. Each value of the positive reactivity change leads to a single positive root, which arises from the combined effect of the prompt and delayed neutrons, and to six negative roots, which are associated with the six delayed-neutron groups. The coefficients, as determined from Eq. 6, are also plotted in Figs. 1–7. It is to be noted that there is but a single positive coefficient corresponding to the term with the positive exponent.

Figures 1–7 may be used to determine the thermal-flux transients in natural uranium-graphite reactors for step changes in reactivity ranging up to 0.4%.

All roots of Eq. 5 are negative for negative reactivity changes. With the substitution of $l' = 10^{-3}$ sec, and the delayed-neutron data given in the table, Eq. 6 becomes

$$A_j = \frac{\prod_{i=1}^{6}(s_j+\lambda_i)\left[10^{-3} + \sum_{i=1}^{6}\frac{\beta_i}{s_j+\lambda_i}\right]10^3}{D + E} \tag{7}$$

where $D = s_j^6 + 16.124s_j^5 - 1.7026s_j^4 - 191.71s_j^3 - 166.79s_j^2 - 23.930s_j - 0.5085$

$E = (s_j + 7.5900 - 1{,}000\rho) \times (6s_j^5 + 80.620s_j^4 + 130.12s_j^3 + 48.314s_j^2 + 4.4526s_j + 0.07472)$

and the s_j are roots of Eq. 5.

Equations 5 and 7 may be used to extend the reactivity ranges to include negative values.

For applications to other types of thermal reactors, Eqs. 5 and 6 are to be used to determine the exponents and coefficients for Eq. 4.

In considering the order of magnitude of reactivity changes, it is to be noted that reactivities of $\rho = \beta = 0.0076$ permit the reactor to be critical with just the prompt neutrons. For large reactivities, $\rho > \beta$, with s_1 large compared to λ_i, Eq. 5 gives

$$\rho \simeq l's_1 + \beta$$

so that

$$\frac{1}{s_1} = \Lambda = \frac{l'}{(\rho - \beta)} \simeq \frac{l'}{\rho}$$

which represents the reactor period based upon only prompt neutrons. Small reactivities imply that $s_1 + \lambda_i \simeq \lambda_i$, with the subsequent simplification to

$$\rho \simeq s_1 \left(l' + \sum_{i=1}^{6} \frac{\beta_i}{\lambda_i} \right)$$

$$\simeq s_1 \sum_{i=1}^{6} \frac{\beta_i}{\lambda_i} = 0.094 s_1$$

Thus at small reactivities, the stable reactor period is $\Lambda = 0.094/\rho$, and the transient behavior of the reactor is determined solely by the behavior of the delayed neutrons, which can be approximated by a single group of neutrons having

$$\frac{\beta}{\lambda} = \sum_{i=1}^{6} \frac{\beta_i}{\lambda_i}$$

As an example of the application of Eq. 6 and Figs. 1–7, consider a reactivity step change of 0.003. The relative thermal flux increase with time is given by

$$\phi/\phi_0 = 2.216e^{0.1051t} - 0.0391e^{-0.01325t} - 0.3618e^{-0.0532t} - 0.1888e^{-0.2727t} - 0.1261e^{-1.013t} - 0.4919e^{-4.883t} - 0.0090e^{-14.28t} \quad (9)$$

At $t = 0^+$, $\phi/\phi_0 = 1.00$, and the rate of flux change is determined by the behavior of just the prompt neutrons, producing a reactor period of $10^{-5}/0.003 = \frac{1}{3}$ sec. For times greater than $t = 0$, the delayed neutrons increase the reactor period. As the time increases, the additional contributions of the delayed neutrons dampen out, so that after long times, the reactor period is given by $1/s_1$, which for this example equals 1/0.1051, or 9.5 sec. The relative flux increase with time is plotted in Fig. 8.

The inhour equation frequently is used to express the reactivity in units of "inhours" (*3*, *8*). At very small reactivities,

$$\rho = \frac{l' + \sum_{i=1}^{6} \frac{\beta_i}{\lambda_i}}{\Lambda}$$

where Λ represents the stable period. Suppose that the reactivity is such that the reactor power increases steadily by a factor of e each hour. To express ρ in units of inhours, it is necessary to evaluate the conversion factor

$$C = \frac{l' + \sum_{i=1}^{6} \frac{\beta_i}{\lambda_i}}{3{,}600} \text{ (inhours per unit of reactivity)}^{-1}$$

Equation 5 is transformed into the inhour equation by converting the units of reactivity to inhours

$$\text{inhours of reactivity} = \frac{l'}{C\Lambda} + \frac{1}{C} \sum_{i=1}^{6} \frac{\beta_i/\lambda_i}{1/\lambda_i + \Lambda}$$

With $l' = 10^{-5}$, and using the data of the table below for β_i and λ_i, the inhour equation becomes

$$\text{inhours of reactivity} = \frac{37.8}{\Lambda} + \frac{0.79}{0.07 + \Lambda} + \frac{19.72}{0.62 + \Lambda} + \frac{199}{2.19 + \Lambda} + \frac{516}{6.5 + \Lambda} + \frac{2{,}040}{31.7 + \Lambda} + \frac{786}{80.0 + \Lambda}$$

with Λ in seconds.

Several inhour equations, based upon older sets of delayed-neutron data have been reported (*3*, *8*), and Hughes *et al.* (*12*) should be consulted for comparisons with reactor data. (For these other equations, l' has been taken to be 1.5×10^{-5} sec.) For example, a stable reactor period of 9.5 sec, corresponding to a reactivity of 0.003 (see Eq. 9) implies that the power level increases by a factor of e every 9.5 sec. In terms of inhours of reactivity, ρ is calculated to be 114 inhours.

Whereas an inhour, *per se*, is the reciprocal of the period expressed in hours, the equation above must be used to calculate the relations between inhours and reactor period. It is at very small reactivities only that the reactivity expressed in units of inhours is inversely proportional to the reactor period.

Dollars and cents also are used to define units of reactivity. In this case, the reactivity in dollars is defined as (*7*)

$$\frac{k_{\text{eff}} - 1}{\beta} = \frac{k_{\text{ex}}}{\beta}$$

The reactivity is 40 cents for $k_{\text{ex}} = 0.003$, and $\beta = 0.00759$. A $1.20 worth of reactivity corresponds to a $k_{\text{ex}} = 0.009$, and $\rho = 0.009/1.009$.

Two-term method. The first term corresponds to the prompt-neutron fraction, but the second term is fictitious and represents the combined effects of all the delayed neutrons. The two-term solution (*1*) is approximated by

$$\frac{\phi}{\phi_0} = \frac{(s_2 - \rho/l)}{s_2 - s_1} e^{s_1 t} + \frac{(\rho/l) s_1}{s_2 - s_1} e^{s_2 t}$$

The roots s_1 and s_2 are obtained from the equation

$$l' s - \rho + \beta/(s + \lambda) = 0$$

With $\beta = 0.00759$, $\lambda = 0.08056$, and with $\rho = 0.003$, and $l' = 10^{-5}$

$$\phi/\phi_0 = 1.618e^{0.0512} - 0.618e^{-4.722}$$

As shown in Fig. 8, the two-term approximation is not satisfactory and becomes progressively worse for larger values of time.

Included in Fig. 8 are values obtained using a Westinghouse portable electronic kinetic simulator (*10*). Although the simulator as used was wired for a slightly different set of delayed-neutron data, the agreement is excellent.

Constants for Delayed Neutrons From U^{235} Fission*

$t_{1/2}$ (sec)	λ_i (sec^{-1})	β_i
0.05	13.86	0.00029
0.43	1.61	0.00084
1.52	0.456	0.0024
4.51	0.154	0.0021
22.0	0.0315	0.0017
55.6	0.0125	0.00026

* Data from Soodak and Campbell (*1*). See Hughes *et al.* (*12*) and Sun *et al.* (*13*) for original report and comparisons of delayed-neutron data.

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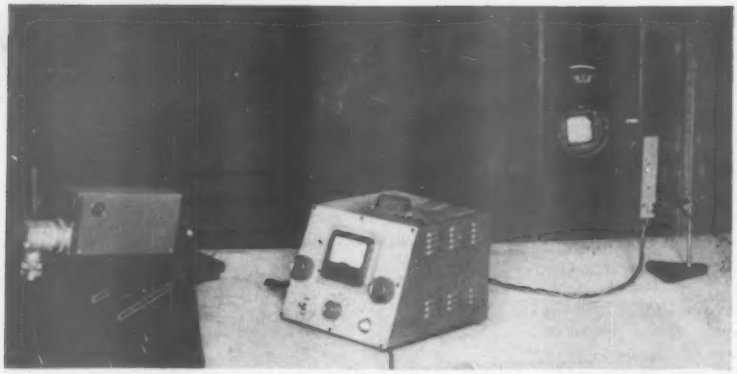

EXPERIMENTAL setup, showing television camera, indicator, X-ray generator, and detector

Energy Dependence of Scintillating Crystals

Crystals herein reported are energy dependent; anthracene characteristics are most suitable for roentgen measurements. Data obtained using 30–250 X-rays compare well with curves calculated from photoelectric and Compton absorption coefficients

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ENERGY DEPENDENCE of the response of scintillation counters and crystal dosimeters, as compared with that of an air-equivalent chamber, is fundamental to the measurement of roentgens or roentgens per second. The literature contains investigations of the energy dependence of alkali halides as regards the production of color centers (*1*, *2*). This paper gives the results of an investigation of the general dependence of the light output of various crystals on the energy of the incident radiation.

Theoretical Considerations

The theoretical response curves are obtained under the assumption that the light efficiency of a crystal is independent of the energy of the incident radiation. Thus, the light output of a crystal will be proportional to the total energy absorbed.

A precise calculation of the total energy absorbed from a gamma-ray beam by a thick crystal is not easily performed. Absorption of energy from an initially monochromatic beam is complicated by the presence of photons of lower energy which are produced by Compton scattering. One could assume that the intensity of gamma radiation at every x is given by $E_0 e^{-\mu_\tau x}$ where μ_τ is the total absorption coefficient of the material for the incident photons and E_0 is the energy per square centimeter in the incident gamma radiation, which is assumed to be monochromatic. If

$$dE = \mu E_0 e^{-\mu_\tau x} dx \qquad (1)$$

is taken as the energy absorbed in dx at x, the absorption of degraded quanta would be entirely neglected. In Eq. 1, $\mu = \tau + \sigma_a$ is the true absorption coefficient, where τ is the photoelectric absorption coefficient and σ_a represents the absorption of energy transferred to electrons by Compton encounters. On the other hand, one could make the approximation that

$$dE = \mu E_0 e^{-\mu x} dx \qquad (2)$$

This procedure does consider that the intensity at each x is larger than that given by Eq. 1. Clearly it also subscribes to a fiction which can be expressed in one of two alternate ways: either it assumes that the degraded quanta move in the x-direction and are absorbed with the same μ as are the primary quanta, or that it is permissible to assume equivalence between loss of a certain amount of *energy* from the beam and loss of a certain *number*

of quanta having total energy equal to that absorbed by the crystal.

Of the two expressions given for dE, Eq. 2 is preferred as a method of taking into account in some approximate manner the contribution of degraded quanta. The distinction is certainly insignificant in the low-energy region where photoelectric absorption predominates. The results obtained may not differ too much even in the energy region where Compton absorption contributes appreciably, since the factors occurring in the final expression obtained from Eq. 1 for the total absorbed energy tend to compensate each other. A few sample calculations were made using Eq. 1 in its integrated form. It was found that the response curves so obtained have the same general shapes as those obtained from Eq. 3, given later. A rigorous procedure, wherein one considers the intensity spectrum at every x, would introduce undesirable complications so far as this study is concerned.

Unfortunately the method adopted does not provide an estimate of the accuracy of the results obtained. The close agreement between results obtained by these two methods would seem to indicate that the approximation is rather good—at least in the energy range covered.

If Eq. 2 is integrated over the thickness of the crystal, the total absorbed energy is

$$E_t = E_0(1 - e^{-\mu d}) \qquad (3)$$

where E_t is the total energy absorbed by a crystal of 1-cm² area normal to the radiation and of thickness d.

Since we are interested in the response of the material as compared with that of air, the following ratio has been computed

$$R = \frac{(1 - e^{-\mu d})}{(\mu d)} = \frac{\text{crystal response}}{\text{air response}} \qquad (4)$$

The exponential which would have been in the denominator has been replaced by the first two terms of its expansion since $(\mu d)_{air} \ll 1$. These ratios are plotted on this page.

Computation of Coefficients

The photoelectric absorption coefficients were calculated by using the formula given by Victoreen (*3*). Compton absorption coefficients were calculated by using the Klein-Nishina formula (*4*). The total absorption coefficients are listed in Table 1. The mass absorption coefficients μ/ρ of the crystal compounds, listed in Table 2, are given by

$$(\mu/\rho)_{crystal} = \frac{1}{W} \Sigma w_i(\mu/\rho)_i \qquad (5)$$

where w_i is the weight of element i in the crystal and W is the total weight of the compound.

Experimental Procedure

The light output was measured with a commercial photovolt instrument and a photographic shutter and container adapted to fit the window of a 1P21 photomultiplier. The readings were taken remotely by means of a television camera and receiver. A constant-potential Westinghouse X-ray generator, operating at 30–250 kv, served as the source of gamma rays.

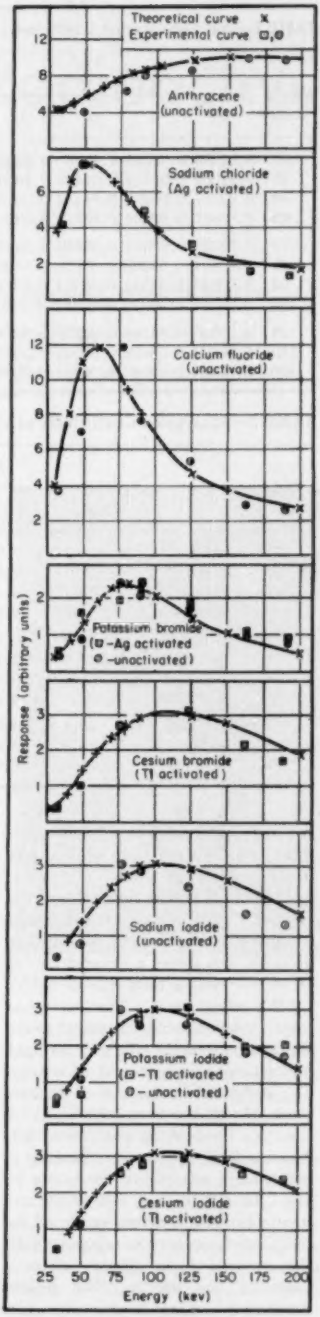
The X-ray beam was collimated by means of a lead shield placed at the exit window of the machine. The shield had a thickness of 4 mm and contained a square aperture having a side of 8 cm. The experimental setup is pictured on p. 72.

An absorption experiment was performed with aluminum, copper, cadmium, and lead filters. Effective energies for various filter combinations were determined from the curves of intensity versus thickness of filtering material. A constant dose rate of 2 r/min, as determined by a Victoreen 25-r chamber, was used throughout the experiment. This gives experimental values which are relative to that of an air-equivalent chamber. Anthracene was used as a monitor by taking readings at the beginning and end of each exposure at any one energy. All crystals were approximately 1 cm thick, except for the activated KBr crystal which was 2 cm thick.

Conclusions

The experimental curves were adjusted to those of the theory by multiplying the observed values by the ratio of peak-theoretical to peak-observed value. On comparing the response of the activated crystals with that of the pure crystals, it was found that the only effect of the activator was to increase the light output by a factor of 10–100 with no apparent change in the basic response curves. The observed data follow the general shapes of the calculated curves.

All the crystals are quite energy dependent, and could not be used


Theoretical curve
Experimental curve ⊡,⊙
Anthracene (unactivated)
Sodium chloride (Ag activated)
Calcium fluoride (unactivated)
Potassium bromide (⊡ –Ag activated ⊙ –unactivated)
Cesium bromide (Tl activated)
Sodium iodide (unactivated)
Potassium iodide (⊡ – Tl activated ⊙ – unactivated)
Cesium iodide (Tl activated)
Response (arbitrary units)
Energy (kev)
25 50 75 100 125 150 175 200

EXPERIMENTAL and calculated crystal responses vs energy of incident X-rays

TABLE 1—Total Absorption Coefficients of Elements Calculated from Photoelectric and Comption Absorption Coefficients

Energy (kev)	Absorption coefficients of crystal elements (μ/ρ cm²/gm)												
	H	*C*	*N*	*O*	*F*	*Na*	*A*	*K*	*Ca*	*Br*	*I*	*Cs*	*Cl*
30	0.01875	0.09387	0.1508	0.2285	0.3898	0.5919	2.545	3.251	3.916	17.90	.....	47.57	2.260
40	0.02260	0.04704	0.07109	0.1040	0.1395	0.2578	1.093	1.396	1.683	7.964	22.59	24.30	0.9702
50	0.02757	0.03217	0.04449	0.06139	0.07916	0.1400	0.5705	0.7283	0.8773	4.210	12.65	13.75	0.5075
60	0.03067	0.02604	0.03318	0.04298	0.05290	0.08828	0.3385	0.4311	0.5183	2.493	7.745	8.470	0.3021
70	0.03420	0.02391	0.02840	0.03459	0.04045	0.06286	0.2207	0.2798	0.3352	1.598	5.071	5.567	0.1980
80	0.03696	0.02309	0.02610	0.03024	0.03378	0.04888	0.1544	0.1946	0.2320	1.087	3.499	3.845	0.1395
90	0.03853	0.02255	0.02467	0.02758	0.02975	0.04042	0.1144	0.1432	0.1698	0.7751	2.511	2.769	0.1043
100	0.04050	0.02270	0.02424	0.02637	0.027616	0.03573	0.08914	0.1106	0.1302	0.5742	1.867	2.061	0.08214
125	0.04525	0.02398	0.02476	0.02585	0.02585	0.02998	0.05685	0.06875	0.07914	0.3077	0.9961	1.098	0.05395
150	0.04803	0.02488	0.02533	0.02597	0.02538	0.02786	0.04285	0.05117	0.05685	0.1889	0.5943	0.6571	0.04180
200	0.05233	0.02669	0.02731	0.02715	0.02605	0.02725	0.03269	0.03710	0.04020	0.09458	0.2699	0.2976	0.03318

TABLE 2—Absorption Coefficients of Compounds Calculated from Element Absorption Coefficients

Energy (kev)	Absorption coefficients of crystal compounds (μ/ρ cm²/gm)								
	Air	$C_{14}H_{10}$	CaF_2	*KBr*	*NaI*	*KI*	*CsI*	*CuBr*	*NaCl*
30	0.1996	0.08962	2.200	13.09	.....	.....	.....	36.43	3.473
40	0.09184	0.04566	0.9316	5.807	19.16	17.60	23.46	18.17	1.494
50	0.05517	0.03191	0.4888	3.066	10.73	9.840	13.21	10.17	0.7857
60	0.03938	0.02630	0.2918	1.815	6.570	6.022	8.115	6.225	0.4720
70	0.03230	0.02449	0.1917	1.162	4.303	3.943	5.325	4.077	0.3135
80	0.02871	0.02388	0.1355	0.7936	2.970	2.721	3.676	2.809	0.2249
90	0.02650	0.02345	0.1016	0.5675	2.132	1.954	2.643	2.020	0.1714
100	0.02556	0.02371	0.08027	0.4219	1.586	1.453	1.966	1.502	0.1383
125	0.02543	0.02518	0.05320	0.2292	0.8479	0.7777	1.048	0.8011	0.09639
150	0.02570	0.02619	0.04153	0.1437	0.5120	0.4664	0.6264	0.4813	0.07863
200	0.02734	0.02814	0.03331	0.07570	0.2327	0.2151	0.2841	0.2214	0.06679

without some type of filter for measurement of radiation dosage or dose rate in the range of energies covered. Anthracene is the most suitable of the crystals. Its response, as shown graphically on p. 73, is flat from 150 kev upwards, but shows a faster dropping off at low energies than is predicted by the theoretical curve. The theoretical response was determined subject to the assumption that the efficiency for light production is independent of energy. The differential efficiency of fluorescence, dL/dE, has been determined for electrons incident on anthracene (*5*). About a 20% decrease in efficiency is indicated in going from 100 kev to 27 kev. In this energy range, the response to photoelectrons produced by the X-ray beam may be compared with the response to a primary electron beam of like energy. The results obtained by using X-rays show the same type of behavior as that reported by Taylor (*5*). This behavior is in qualitative agreement with the theory, as proposed by Kallmann (*6*), that the efficiency for light production decreases if the density of ionization becomes sufficiently large.

It should be observed that for the heavier crystals the factor $e^{-\mu d}$ is approximately zero over most of the energy range investigated, and consequently the response is given by the reciprocal of the absorption coefficient of air. This does not apply to anthracene at any energy.

Experimental and theoretical curves for the production of color centers have been given as a function of the energy of the incident radiation (*1*, *2*). Although the latter method of determining the energy dependence differs from that of the present report, the experimental results should agree since the fundamental process of energy absorption is the same in both cases. In the case of potassium bromide, the only crystal common to all three reports, agreement is obtained as regards the general shape of the curves. The following tabulation compares experimental and theoretical peak values (kev)

	ESL	*NRL* (*1*)	*Armour* (*2*)
Theoretical	80	100	80
Experimental	75–85	75–80	No value

Since the peaks of the experimental curves are not sharp, the range in which the KBr peak occurs is tabulated.

* * *

The writer wishes to express appreciation for valuable discussions held with Dr. W. Ramm and Dr. W. S. McAfee of this Laboratory during the experimentation and subsequent preparation of the report.

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Aerial Surveying for Radioactive Ground Contamination

Tests, employing Co, Cs, Na, and Ta sources to simulate ground contamination resulting from radiological warfare, indicate that light aircraft and commercial G-M survey meters provide a feasible method for surveying large ground areas

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THE POSSIBILITY that large ground areas may become contaminated with radioactivity resulting from radiological warfare, atomic bombings, sabotage, or accidents in radioisotope-production industries, emphasizes the need for a rapid method of ground surveying. Preliminary experiments were made to test the practicability of using light aircraft and commercially available radiation-detection equipment.

Instrumentation

The radiation detector should possess several qualities: ruggedness, sensitivity, mobility, simplicity, relative economy, and availability.

The scintillation-counter survey meter offers certain advantages for this type of surveying, but was not considered because of its current high cost and lack of commercial availability. As expected, the ionization-chamber-type instruments were not sensitive enough to obtain positive data in most cases.

The Zeus, Cutie Pie, and one type of civilian defense instrument, which is direct reading from approximately 0 to 500 r/hr, were checked. Tests with 18 Ta sources (totaling approximately 720 curies), at a ground speed of approximately 60 mph and an altitude of 500 ft, produced readings of 5 mr/hr on the Zeus and the Cutie Pie. The arrangement of the sources is shown in Fig. 1. At an altitude of 200 ft, the Cutie Pie indicated a radiation dose rate of approximately 80 mr/hr. The response times of the Zeus and the civilian defense instrument were too slow to give significant readings under these conditions.

A G-M-type detector best satisfies the requirements. With normal care, this type of instrument operates well in all weather conditions, including high relative humidity. In cases of wide variation in temperature, and for very high counting rates, the G-M tube should contain a halogen gas, because of its satisfactory operation over a wide range of temperatures and its almost unlimited life.

Practically all of the commercially available G-M survey instruments considered have three sensitivity ranges calibrated in counts per minute or milliroentgens per hour. The most critical component is the thin-walled G-M tube. In general, most instruments have a removable shield which serves to protect the tube while the instrument is being transported, in addition to its use as a radiation absorber. Most of the commercial models give a minimum battery life of at least 150 hr of continuous operation. The size and weight vary, but most types have a volume less than 400 in.^{3}, and weigh less than 10 lb.

FIG. 1. Arrangement of tantalum sources

Radiation Sources

The following types and quantities of sources were used in the tests:

Cobalt-60. A total of 37 curies of Co^{60} consisted of six sources, of which four sources were approximately 6.4 curies each, one source was approximately 4 curies, and one source was approximately 8 curies. For identification purposes, the sources were labeled *A*, *B*, *C*, *D*, *E*, and *F*. *A*, *B*,

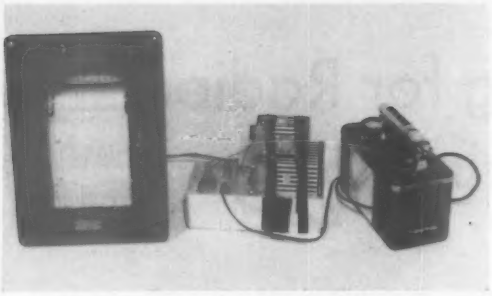

FIG. 2. Recorder, power supply, and G-M detector used

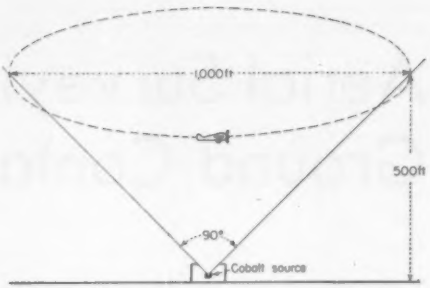

FIG. 3. Unshielded, collimated beam of Co^{60} source

C, and *E* were 6.4 curies; *D*, 8 curies; and *F*, 4 curies.

Cesium-137. The single Cs^{137} source contained approximately 6.4 curies.

Sodium-24. Approximately 0.87 curies were contained in one Na^{24} source.

Tantalum-182. A total of approximately 720 curies of Ta^{182} consisted of 18 sources of about 40 curies each.

Flight Data

On March 20, 1951, flights were made in an L-4 type aircraft for the purpose of determining altitude levels at which a point source involving approximately 4 curies of Co^{60} could be detected with reasonable accuracy. The aircraft carried a pilot and an observer, who recorded the data. The unmodified, commercially available, portable survey instruments used are shown in Fig. 2.

The Co^{60} source was enclosed in a cylindrical, lead-shielded carrier approximately 9 in. in diameter, which was designed to provide a minimum of 4 in. of lead shielding at all points around the source when the carrier was assembled. With the lead plug removed from the top of the carrier, the source gave an unshielded vertical collimated beam at an angular width of approximately 90 degrees (see Fig. 3).

A maximum reading of 3 scale divisions (or 50% above background) was observed on the most sensitive scale at an altitude of approximately 1,000 ft (Table 1). At 500 ft, at an approximate ground speed of 60 mph, it was observed that the plane was in the radiation field for about 10 sec. Contour flying was performed satisfactorily at the latter speed and altitude, with the detector showing approximately half-scale (or 10 divisions) on the most sensitive scale of the instrument.

The observer was often allowed only 1 sec between readings. The radiation dose-rate meters had a slow response, meaning that, at low-level flights, they did not have time to reach a maximum reading, and the normal fluctuation of the meter pointer, together with the vibration of the plane, made accurate readings difficult. Inaccuracies in estimating the lateral position and elevation of the plane added to the uncertainties.

On March 22nd, 1951, all experiments were repeated with the exception that the source was removed completely from the lead carrier, thus reducing the collimation effect. As would be expected during these flights, the plane was in the radiation field for a longer period of time on each flight over the source. This gave the slow-response instruments more time to reach a reading corresponding to the dose rate. The source was detectable at an altitude of 500 ft while the plane was flying over a point 1,000 ft from the source at ground level, as in Fig. 4. All subsequent flight tests were made with uncollimated sources.

On August 27th, flights were made over the Na^{24} source at altitudes of approximately 100, 200, 300, and 400 ft. Experimental readings and the calculated values for the various altitudes are shown in Table 2.

On August 28th, flights were made over Co^{60} sources *A*, *B*, *C*, *D*, and *E*, at altitudes of 200, 500, and 1,000 ft. The sources were arranged in the pattern shown in Fig. 5. Also, flights were made over these sources when they were placed close together, essentially forming a 37-curie point source of Co^{60}. The results of experimental readings and the calculated values are given in Tables 3, 4, and 5.

Figures 5, 6, and 7 show the readings obtained from the G-M survey meter wired to the Esterline Angus recorder as compared to the calculated values derived from data taken at altitudes of 160, 500, and 1,100 ft flown over a line of sources arranged as indicated in the figures.

Figure 8 compares calculated values with experimental readings obtained by flying over the sources, arranged as indicated, at an altitude of 500 ft. These particular data were obtained from two flights, one directly over the center of the square, the other flying at a distance of approximately 400 ft from one side of the 200-ft square. The

TABLE 1—Typical Data with 4-Curie Source of Co^{60}

Altitude (ft)	*Instrument reading (mr/hr)*	*Calculated reading with uncollimated source (mr/hr)*
1,000	0.01	0.022
800	0.03	0.044
600	0.05	0.099
400	0.18	0.260
200	1.00	1.200

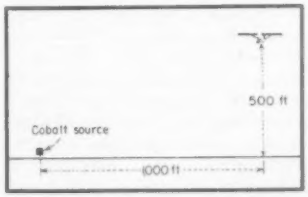

FIG. 4. Flight path for determining detection limit for uncollimated Co^{60} source

TABLE 2—Experimental and Calculated Values with 0.87-Curie Na^{24} Source

Altitude (ft)	*Instrument reading (mr/hr)*	** Calculated reading (mr/hr)*
400	0.15	0.19
300	0.30	0.30
200	0.70	0.46
100	1.90	2.00

TABLE 3—Co^{60} Sources *A, B, C, D,* and *E* arranged as Shown in Fig. 7

Altitude (ft)	*Maximum reading of instrument (mr/hr)*	*Maximum calculated reading (mr/hr)*
1,100	0.07	0.084
500	0.60	0.530
160	4.00	3.900

TABLE 4—Co^{60} Sources *A, B, C, D,* and *E* Arranged as Shown in Fig. 10

Altitude (ft)	*Maximum reading of instrument (mr/hr)*	*Maximum calculated reading (mr/hr)*
1,000	0.08	0.18
500	1.40	1.20
200	7.50	7.40

TABLE 5—Co^{60} Sources *A, B, C, D,* and *E* Arranged as 33.6-Curie Point Source

Altitude (ft)	*Maximum reading of instrument (mr/hr)*	*Maximum calculated reading (mr/hr)*
1,000	0.1	0.19
500	1.5	1.30
200	12.0	10.00

TABLE 6—Cs^{137} Source of 6.4 Curies

Altitude (ft)	*Maximum instrument reading (mr/hr)*	*Maximum calculated reading (mr/hr)*
500	0.03	0.022
200	0.30	0.350

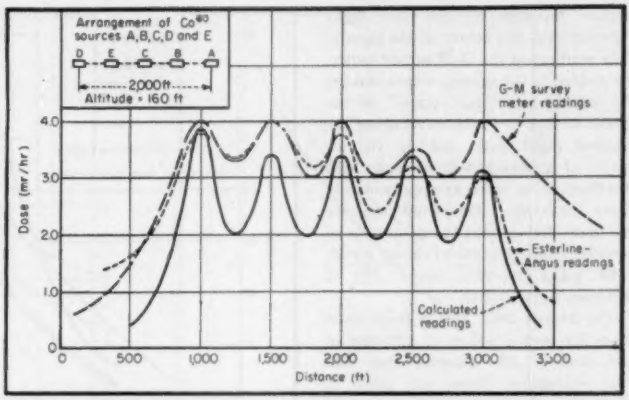

FIG. 5. Calculated and flight data obtained at an altitude of 160 ft, with Co^{60} sources A, B, C, D, and E arranged as indicated

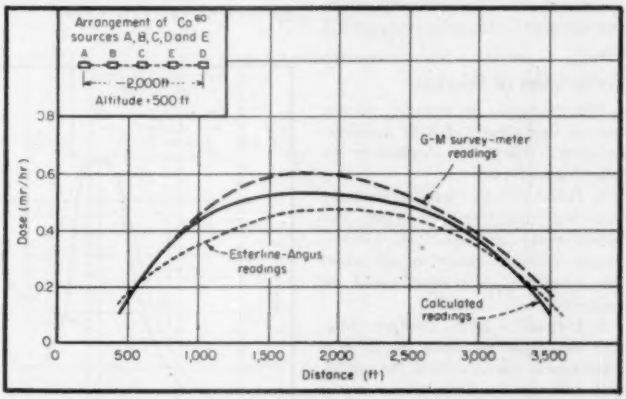

FIG. 6. Calculated and flight data obtained at an altitude of 500 ft, with Co^{60} sources arranged as indicated

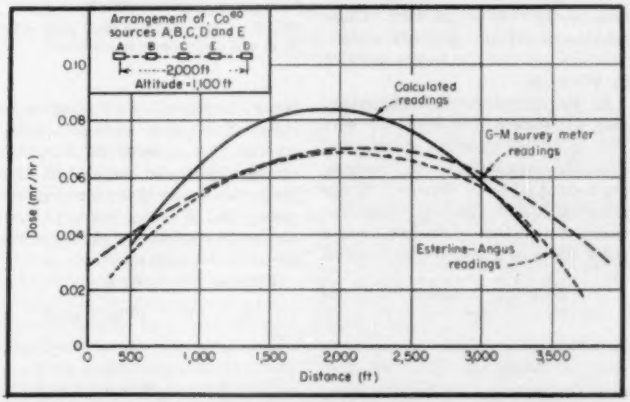

FIG. 7. Calculated and flight data obtained at an altitude of 1,100 ft, with Co^{60} sources arranged as indicated

higher readings are for the flight directly over the center of the square. The readings of the G-M survey meter, as plotted in the graphs, were obtained by setting the "true course" of the plane so that it would travel along the desired flight path, holding the air speed at approximately 60 mph, with readings being taken at approximately 2-sec intervals. The wind velocity was near zero so that the ground speed was very nearly equal to the air speed. The plane traveled about 170 ft between each reading.

On August 30th, flights were made over the cesium source at altitudes of 200 and 500 ft. Experimental data and calculated values are given in Table 6.

On August 31st, flights were made over cobalt sources arranged as indicated in Fig. 9. Experimental results and calculated values are compared in Fig. 9.

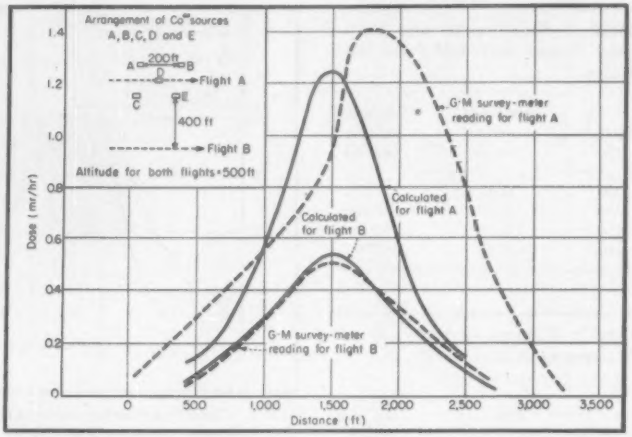
Arrangement of Co⁶⁰ sources A, B, C, D and E
200 ft
Flight A
400 ft
Flight B
Altitude for both flights = 500 ft
G-M survey-meter reading for flight A
Calculated for flight A
Calculated for flight B
G-M survey-meter reading for flight B
Dose (mr/hr)
Distance (ft)

FIG. 8. Calculated and flight data obtained by flying over Co^{60} sources, arranged as indicated, by flight paths A and B

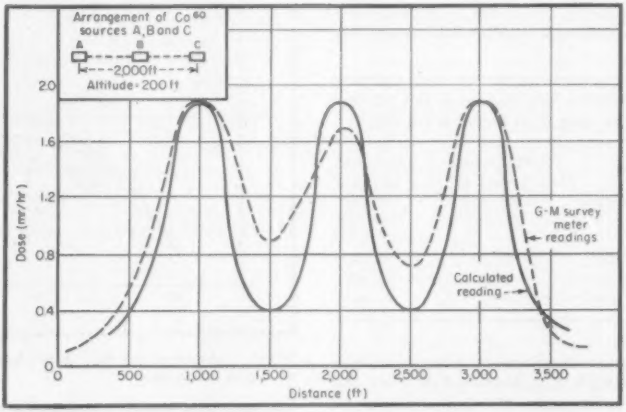

FIG. 9. Calculated and flight data obtained at an altitude of 200 ft, with Co^{60} sources A, B, and C arranged as indicated

Calibration of Sources

The strength, or activity, of the sources was measured with moderate accuracy. They were checked by the following methods:

1. Estimated by making roentgen dose-rate measurements with Victoreen meters and Lauritsen Electroscopes at close range in air where the scattering correction could be neglected.

2. Estimated from roentgen dose-rate measurements made in air at a considerable distance from the sources with a Lauritsen Electroscope in the case of the Co^{60}, Cs^{137}, and Na^{24} sources.

3. Measured under water in a large tank in the case of the Co^{60}. Comparisons were then made with calibration data and build-up factors reported by White (*1*).

In the second method, theoretical data of Morgan and Ford (*2*) were used in making estimates of the curies from the measurement of roentgens per hour at a known distance. It was assumed that the dose D, in mr/hr/curie, at a distance r, in feet, from a point source is given by the equation

$$D = \frac{NB}{r^2} \sum_i n_i R_i e^{-\mu_i r} \qquad (1)$$

in which N = number of curies (a curie is defined as 3.7×10^{10} dps), n_i = the fraction of the disintegrations that results in the emission of a gamma photon of E_i Mev, μ_i = the total linear coefficient of absorption of energy E_i (*3*) in air at density 0.0012 gm/cm³ (the value at 22° C and 76 cm Hg), R_i = the mr/hr 1 ft from the 1-curie source that emits a gamma energy E_i, B = the build-up factor due to the scattering of radiation from the air and from the ground.

The equation for R_i is

$$R_i = 1.69 \times 10^4 (\mu - \sigma_a)_i E_i \qquad (2)$$

where $(\mu - \sigma_a)_i$ = total coefficient (cm^{-1}) of absorption minus the Compton scattering coefficient (*3*) in air for photons of energy E (Mev). The value of B in air, determined from a series of experiments (most of them with Co^{60}), is given approximately by the equation

$$B = 1 + 5 \times 10^{-4} r^{1.28} \qquad (3)$$

No great accuracy is claimed for this equation in determining the build-up factor. It applies fairly well as a scattering correction to dose-rate measurements made a few feet above the ground and at various distances from a Co^{60} source, but may be a poor approximation to the true build-up with other sources.

Figures 10 through 13 are plots of Eq. 1. The solid curves are for the

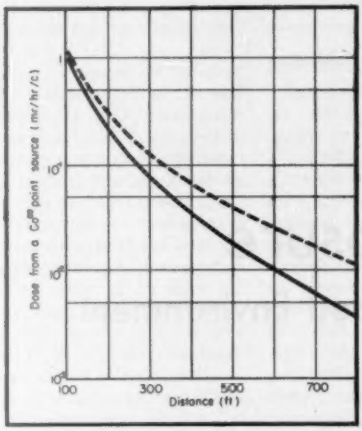

FIG. 10. Build-up factor, calculated from Eq. 3, for a Co^{60} point source

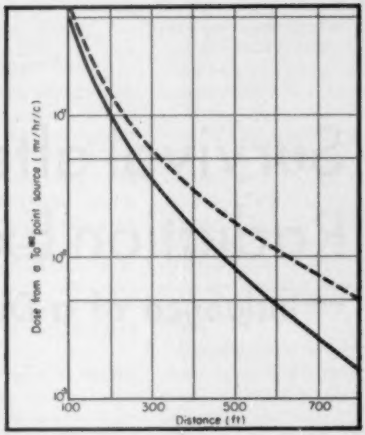

FIG. 11. Build-up factor, calculated from Eq. 3, for a Ta^{182} point source

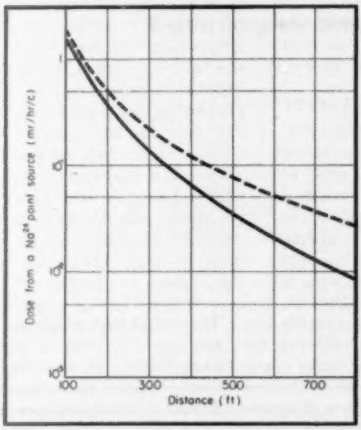

FIG. 12. Build-up factor, calculated from Eq. 3, for a Na^{24} source

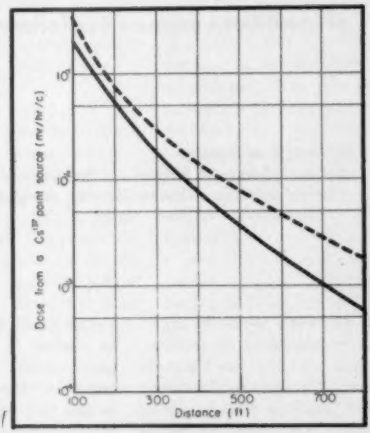

FIG. 13. Build-up factor, calculated from Eq. 3, for a Cs^{137} point source

case where the build-up factor is 1, and the dashed curves for the case where the build-up factor is given by Eq. 3. These figures were used for determining the calculated values of Tables 1–6.

Conclusions

Although there was reasonable agreement of experimental and theoretical data, these experiments were intended to check the operation of commercially available radiation-detection instruments, and were not an attempt to check or develop the theory of radiation attenuation and scatter. As would be expected, in some cases there was considerable deviation of the experimental from the theoretical data. This, however, does not nullify this method of radiation survey as perhaps the most promising method of quickly surveying a contaminated area.

If better quantitative data is needed, fast-response, scintillation-counter equipment may be developed for this application.

* * *

The first group of tests were made possible through the cooperation of the Tennessee State Civil Air Patrol, with direct assistance from Capt. E. J. Keen and Lt. Curtis R. Palmer of the Oak Ridge unit. R. D. Birkhoff, technical advisor to the Civilian Defense Group for the State of Tennessee, and G. E. Miller, head of General Safety for the Municipal Operations of Oak Ridge, collaborated on major problems.

The second series of tests were made possible by the active participation of H. H. Abee, A. D. Warden, and other members of the Health Physics Division, ORNL. Further acknowledgement is extended to Dr. John H. Rust and members of the staff of the University of Tennessee's Agriculture Experimental Station who provided test sites and certain types of radioactive sources.

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Survival after Radiation Exposure
—Influence of a Disturbed Environment

Irradiated mice and rats have been subjected to fatiguing exercise, poor diet, and infection, in experiments to evaluate the effects of conditions expected to follow an atomic-weapon attack

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IT WOULD BE WELL for us to know, with as much assurance as possible, how changes in the environment brought about by an atomic attack would affect survival after exposure to radiation. Destruction of homes and a breakdown of transportation will entail exposure and unaccustomed physical exertion. First aid and food supplies will be limited. Satisfactory facilities for sanitation will almost surely be lacking. In addition to the manifest casualties from heat, blast, and flying missiles, there will be those victims who do not know whether or not they are sick, and to what extent they can remain active without jeopardizing their chance of survival.

We have attempted to evaluate the effect of a disturbed environment upon radiation injury by studying laboratory animals placed, after whole-body X-irradiation, in situations comparable to those which would be encountered by man.*

The small laboratory animals can be studied in numbers sufficient for generalization within the chosen population, but the extension of conclusions to man must be made only with appropriate reservations. Extrapolating from mouse to rat, or even from one group of mice or rats to another, is unwarranted in certain respects. By the same token, extrapolation from other primates to man may be equally misleading. Observations on many species are being collected, however, which will continue to strengthen the validity of conservative generalizations.

An additional reason for the exercise of caution in extrapolating from animal to man is the strong psychosomatic reaction which can be expected in man when he knows, or thinks, that he has been exposed to high-energy radiation. The fear of that which can be neither seen nor felt while it destroys—not immediately, but after days of uncertainty—causes panic, depression, and illness. These reactions superimposed upon true radiation effects may be difficult to appraise in the absence of adequate laboratory facilities, and their influence on the course of radiation illness cannot be evaluated by animal experimentation.

We believe that information concerning effects of various environmental disturbances following radiation will serve to allay fear and reduce complicating psychogenic reactions.

* Many of these experiments are from our own laboratory; though others are discussed, a complete review of the literature is not attempted.

Exercise

Mice and rats that are obviously sick after irradiation cannot tolerate long periods of exercise as well as healthy animals, but after radiation doses in the low lethal range, or during the few days that the animals look well after higher doses, their tolerance to long

periods of moderate exercise compares favorably with that of nonirradiated controls.

The effect of exercise on radiation lethality has been studied in mice and rats. Results of these experiments, summarized in Table 1, are given in some detail because of their importance if extrapolation to man is anticipated.

These mice and rats suffered relatively little permanent damage from being forced to walk in the treadmill for the periods indicated, taking as the criterion mortality at 30 days. In only occasional groups is the increase over control mortality statistically significant (*1, 2*). On the other hand, rats weighted and made to swim to exhaustion in water sometimes as cold as 60° F consistently showed an increase in mortality (*3*). The difference seems to be due to the greater intensity of the swimming experience, although it is questionable that other factors can be entirely ruled out.

Perhaps the most important aspect of these results is the fact that the effect of exercise on radiation lethality is so small. Both types of exercise are very severe. In one case, the rats had to swim until they could no longer rise to the surface, while in the other the walking period was long with no time allowed for rest, eating, or drinking (in each period of walking, the rats lost about 10% of their weight). Considering the additional fact that many of the animals were quite ill when they were forced to walk or swim, the proportion surviving seems remarkably high.

Environmental Temperature

In the chilled frog and the hibernating woodchuck, metabolic rate is greatly reduced and the development of radiation damage is delayed, though not ultimately diminished (*4, 5*). In mice and rats, the metabolic rate is increased in the cold, and deaths after radiation are more numerous than when the animals are kept in a warm environment (*6, 7*). Of 140 mice caged singly in a room kept at 50° F, 69% died compared to 39% of those kept at 86° F.

Thyroid or dinitrophenol feeding also increases metabolic rate and radiation lethality, but thyroidectomy, antithyroid substances, and sedation are not, conversely, beneficial (*8, 9*).

The mechanisms involved remain obscure, but the evidence indicates that exposure to extreme cold, or to intense and exhaustive activity, would be unwise after severe irradiation.

Hypoxia

In experiments designed to simulate evacuation by air, it was shown that four hours at 20,000 feet altitude had no demonstrable effect on radiation lethality in mice (*10*). In a single experiment, sublethally irradiated rats withstood daily exposures to 25,000 feet for a significantly longer time than their controls (*11*). Irradiated mice have been shown to tolerate acute hypoxia slightly better than controls (*12*), and it has recently been reported that tolerance of rats to acute hypoxia under reduced barometric pressure is not altered by previous exposure to X-ray (*13*).

During the anemic phase, one would expect the limits of tolerance to hypoxia to be somewhat lower in irradiated than in normal animals, but this has not been demonstrated and, for practical purposes, it seems safe to conclude that radiation gives rise to no peculiar sensitivity to anoxia.

Food

It is probable that an atomic disaster would cause a local shortage of food or of certain kinds of food. Enforced fasting for moderate periods of time, however, does not perceptibly influence the lethal response to radiation in mice, rats, or guinea pigs (*14*).

The eating patterns of these animals after irradiation differ widely, and are apparently characteristic of the species. It is interesting, but perhaps coincidental, that guinea pigs, which continue to eat and gain weight during the first days following irradiation, have a very high degree of susceptibility to radiation while rats, which refuse practically all food and lose weight precipitously, are relatively resistant.

In rats there is a marked stasis of gastric contents for several days after irradiation, which seems sufficient to account for their refusal of food,

TABLE 1—Exercise Effect on Radiation Lethality in Mice and Rats

Animals	*Type and duration of exercise**	*Dose (r)*	*No. of animals*	*Mortality (%)*
Mice (*1*)	Walking 8 hr/day, 3 days	400	240	18
	None	400	88	12
	Walking 4 periods of 3 hr each/day, 14 days	500	40	65
	None	500	50	54
	Walking 8 hr/day, 21 days	470	40	28†
	None	470	60	12
Rats (*2*)	Walking 7.5 hr/day, 9 days	490–620	135	76
	None	490–620	223	60
	Walking 7.5 hr/day, days 1–3 or 2–6 postirradiation	515–570	81	73
	Walking 7.5 hr/day, days 6–8, 7–8 or 7–15 postirradiation	515–570	78	72
	None	515–570	135	66
Rats (*3*)	Swimming to exhaustion 5 days/wk, 4 wk	500–700	173	61
	None	500–700	162	17

* Rate of walking, 0.17 miles/hr in a motor-driven treadmill. Duration in the first group 3 consecutive days within the first 15 days after irradiation, in the other groups consecutively for the days indicated, beginning the day following irradiation.

† Adjusted by subtracting 25%, which was the mortality of simultaneously exercised nonirradiated controls.

and forced feeding by stomach tube at that time is distinctly harmful, even when the food is partially predigested (*14, 15*).

Although a low-protein diet given to young rats for several weeks before and continued after irradiation was associated with a slightly increased mortality (Table 2), when this protein-deficient diet was given only after irradiation it did not impair, nor did a high-protein diet significantly improve, the proportion surviving seven weeks later (*16*). None of the vitamins studied appear to be of consistent therapeutic benefit.

In questions of alimentation, the observed species differences make it particularly advisable to exercise caution in attempting to extrapolate to man. Nevertheless, it seems probable that short periods without food, or longer periods with moderately poor diets, will not prove to be a major factor in survival after radiation.

Adrenal Function

Severe impairment of adrenocortical function causes a decrease in tolerance to various well-known types of stress. Results of the experiments dealing with exercise, cold, and altitude, and tests of tolerance to injected KCl or histamine (*17*) indicate that specific adrenal damage due to radiation is not sufficient to render the animal incapable of tolerating moderate degrees of stress, at least until it is about to die of other radiation sequelae.

Although mice with intact adrenals have been shown to tolerate radiation better than adrenalectomized mice (*18*), and adrenal shielding was to some extent protective in irradiated rats (*19*), treatment of irradiated mice with ACTH or cortisone has not proven beneficial (*20*).

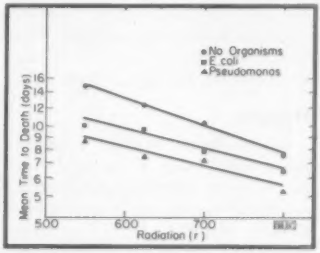
Hemorrhage

One of the most characteristic of the radiation effects, observed both in the Japanese casualties and in a large variety of experimental animals, is the development of a marked hemorrhagic tendency. Capillary fragility is increased and platelet counts reach vanishingly low levels, resulting in a bleeding defect which can be corrected by infusions of freshly prepared platelets (*21*). This treatment has not reduced mortality in irradiated dogs under normal laboratory conditions, and the amount of platelets necessary to maintain an effective level is such that its use should be considered only in special cases (*22*).

The bleeding tendency does not usually appear until about a week after irradiation and it may then persist for a week or more, coinciding, in part, with the period of greatest anemia. Disturbances in the environment would constitute a particular hazard during that time by increasing the occurrence of traumatic incidents, but no experimental evaluation of this effect has been reported.

Infection*

The natural defenses against infection are at an extremely low ebb after whole-body irradiation. Mice are abnormally susceptible to infection for as much as two to three weeks following sublethal irradiation, even though the hematopoietic system is then approaching normal (*23, 24, 25*).



CORRELATION between naturally occurring infection and time to death in mice exposed to radiation from 550–800 r

This condition seems to be of general occurrence, although the principal site of invasion may vary from one species to another. In mice, the bacteria found in the blood stream are usually of intestinal origin (*26*), while in dogs the tonsils are a major site of invasion (*27*). In the Japanese casualties, oral and cutaneous ulcerations were commonly observed (*28*).

The extent to which spontaneous infections may affect survival time at different radiation doses is shown in the graph on this page. In this particular group, mean survival times were significantly shorter in the mice that showed infection with *Pseudomonas* or *E. coli* in blood or spleen than in non-infected mice, but survival times were not affected by *α-Streptococcus* infection (*29*).

Response to routine antibiotic treatment varies not only between species but from one experimental group to another. Infection accounts for a large proportion of the deaths in mice following radiation in doses up to approximately 100% lethal if the best results with streptomycin are used as a basis for the estimate (*30, 31*). On the other hand, some groups fail to respond and in occasional groups mortality has been actually higher in antibiotic-treated than in untreated mice (*31, 32*).

Table 3 shows the reduction in mortality and in blood cultures positive for three organisms injected into mice after just sublethal radiation and treatment with streptomycin (*25*). The treatment was completely effective in the mice infected with *Staph. aureus*, and ineffective in those given *Pseudomonas*. In those given *Proteus*, there was some reduction in mortality but a greater reduction in the number showing the organism in the blood stream. Even when streptomycin reduces the degree of infection to the extent that no organisms are cultured from heart blood or spleen at death, the otherwise sublethally irradiated mouse may still die.

Results of routine antibiotic treatment seem to depend upon a complex interaction between specific antibiotic effect and the remaining defense mechanisms of the body. Experimental work with animals certainly substantiates the view that antibiotics will be useful in treating postirradiation infection by sensitive organisms. This has been recently shown for the action of penicillin against beta hemolytic streptocci septicemia in dogs given a 20% thermal burn and 100 r X-ray (*33*).

Results with dogs, guinea pigs, rats, and even mice given radiation in the lethal range have so often been disappointing that they lead one to question the general usefulness of routine antibiotic administration for preventing infection due to radiation uncomplicated by other trauma.

A great advance in the prevention of postirradiation infection at the higher dose levels would be the induction of an early recovery of the body's natural defenses, such as that accom-

* The contributions of our laboratory to this section were supported in part by a grant from the Armed Forces Special Weapons Project.

TABLE 2—Effect of Diet-Protein Content on Radiation Mortality in Rats (*16*)

Casein (%)	*No. of rats*	*Mortality (%)*
Diets before and after irradiation (450–550 r)		
35	63	5
18	64	8
4 or 6	129	26
Diets after irradiation only (600 r)		
60	25	16
18	25	32
6	23	32

TABLE 3—Mortality and Occurrence of Injected Organisms in Blood of Mice Irradiated with 475 r and Infected Subcutaneously 3 Days Later (*25*)

Organism	*No treatment* *No.*	*Mortality†* (%)	*Positive* (%)	*Streptomycin treatment** *No.*	*Mortality* (%)	*Positive* (%)
Staph. aureus	22	91	82	21	10	0
Proteus	22	91	91	22	64	9
Pseudomonas	30	97	97	30	97	93

* Streptomycin treatment 5 mg per mouse per day begun 6 hr after injection of organisms.
† Mortality of nonirradiated infected controls 3 to 9%, and of noninfected irradiated controls 3 to 5%.

plished by spleen or bone marrow transplants in experimental animals (*34, 35*).

Summary

Moderate exercise, moderate degrees of stress, and no food or a poor diet for a short time can be well tolerated under laboratory conditions by the species studied. Extremes of exercise or cold are not so well tolerated, but the extreme conditions imposed in the experiments are not likely to be encountered.

The bleeding tendency does not appear for several days and by then the environmental conditions should be fairly well controlled. A high degree of susceptibility to infection, on the other hand, appears within a few days and may last for several weeks. With little assistance from the body's normal defense mechanisms, the control of infection promises to be an extremely difficult task, but one which is of the utmost importance in post-irradiation prophylaxis and therapy.

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WORLD PROGRESS IN ATOMIC ENERGY

A DECADE has passed since the world's first reactor went into operation under the grandstand of Stagg Field at the University of Chicago. NUCLEONICS will commemorate this event next month with a special report on what 17 countries have done in nucleonics during this decade and what they hope to do during the next one. Watch for this report.

Relation of Film Characteristics to X- and Gamma-Ray Monitoring

The laboratory seeking the benefits of photographic monitoring—low cost, permanence of record, convenience—must also consider the variables affecting the consistency of results. Sensitivity of the film to the quality of radiation and processing techniques are the most important of these factors

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IN THE PHOTOGRAPHIC MONITORING of X- or gamma rays, an estimate of the dosage received depends upon a measurement of the photographic density of a processed film. This density, in turn, depends upon two factors. One, inherent in the photographic material itself, is the variation of sensitivity of the film with the quality of the exposing radiation. The other is the processing procedure, under the control of the operator.

Sensitivity Considerations

By themselves, photographic films cannot give a measurement of the quantity of radiation. They must be suitably calibrated so that the observed densities can be interpreted in terms of roentgens. This, in turn, implies a knowledge of the radiation quality to which the monitoring films have been exposed. In most practical cases, the radiation quality is known or may be determined with sufficient accuracy for monitoring purposes.

Calibrating the material involves exposing films to known quantities of radiation of suitable quality, and developing these films along with the monitoring films. By reading the developed densities on the calibration films, the densities on the monitoring films may be interpreted in roentgens.

Wavelength dependence. The X- and gamma-ray wavelength response curve for monitoring films has been determined by a number of workers with essentially the same results (*1–10*). Such a curve for a typical film, in this case, Kodak Blue Brand X-Ray Film, is shown in Fig. 1 (*8*).

The number of roentgens required to produce a density of 1.0 is plotted against the voltage applied to a tungsten-target X-ray tube. By "light filtration" is meant only the inherent filtration of the X-ray tube plus, in some cases, about 1 millimeter of aluminum. "Heavy filtration" means that filtration was added until the X-ray intensity was the minimum that could be conveniently used. Filtration ranged from 0.05 mm of copper for 20-kv radiation to 14 mm of copper for 220-kv radiation and 1.5 mm of lead for 385-kv radiation.

In other words, "light filtration" implies a wide range of wavelengths and "heavy filtration" implies as narrow a band as can be obtained conveniently by filtration. These are essentially reciprocal sensitivity curves. The range from maximum to minimum—a factor of about 20—and the differences between the curves for light and heavy filtration indicate the large dependence of film response upon radiation quality.

The variation of film response with radiation quality calls for a carefully considered choice of calibrating radiations. By and large, workers are exposed to scattered and stray radiation rather than to direct radiation The calibration, on the other hand, is most easily done with direct radiation. The aim is to set up conditions under which the radiation received by the personnel will not be undervalued.

Consider, for instance, medical diagnostic radiography. It has been found that, in this field, exposure to personnel is largely scatter from the patient being radiographed, and the quality of the radiation is essentially similar to that of the primary radiation. The voltage range used falls at or near the minimum of the "light-filtration" curve in a range over which the film sensitivity does not vary more than 10%. Therefore, any convenient tube voltage in the medical range can be used to expose calibration films.

On the other hand, consider a 250-kvp industrial X-ray unit. If it is an enclosed unit, exposure of personnel —assuming the regularly accepted safety procedures are followed—will be to the radiation transmitted by the protective barrier. In this case, a calibration based on films exposed to the heavily filtered primary radiation will evaluate the exposure to personnel satisfactorily. If it is an open installation, as in a boiler or welding shop, exposure to personnel will be a combination of primary rays filtered through a protective shield and a small proportion of scatter from the object being radiographed. Films calibrated with the heavily filtered primary rays will evaluate the radiation transmitted through the protective barrier

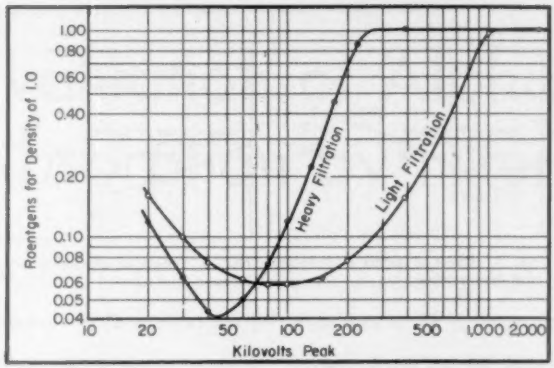

FIG. 1. Roentgens required to produce a density of 1.0 as a function of X-ray tube voltage. Kodak Blue Brand X-Ray Film developed 5 minutes in Kodak Rapid X-Ray Developer at 68° F. (Courtesy of *Radiology*)

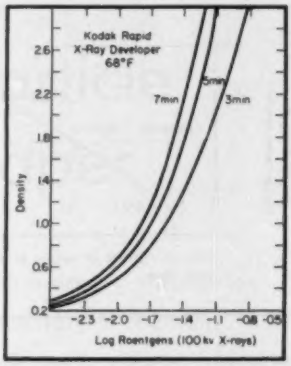

FIG. 2. Characteristic curves of a typical X-ray film (Kodak No-Screen X-Ray Film) developed for various times

correctly and will overvalue the scattered radiation, thus making any error in the direction of increased safety.

Considerable work has been done on the idea of placing absorbers over the film. These absorbers will selectively decrease its sensitivity at the lower kilovoltages and thus decrease the over-all variation in sensitivity (*3, 5, 8–10*), or they will enable the photographic effects of the radiation from various wavelength ranges to be separated and evaluated separately (*11–13*). Such methods result in a considerably more uniform wavelength response than that of the film alone. However, a clear idea of the limitations of a particular filtration technique should be obtained before it is applied to practical monitoring procedures.

In no event, however, can a filter be counted upon to compensate entirely for the wavelength dependence of the film over the whole range of radiation qualities.

The angle at which the radiation strikes the filter governs its effective thickness, which, in turn, affects the quality of radiation reaching the film, with a consequent effect on the wavelength response. This is particularly important when film badges are worn on the person.

Perhaps the best that can be done is to choose filter thicknesses such that, when filter-film combinations are calibrated with normally incident radiation, the radiations incident at other angles are overvalued rather than undervalued.

Speed. This is the other important inherent property of a photographic material that must be considered in radiation monitoring. By "speed of a film" is meant the reciprocal of the exposure in roentgens or other suitable units required to produce a given density under specified processing conditions. The effective speed of a film may be varied by changing the developing conditions, but, in general, it is best to standardize on one development—say, 5 minutes at 68° F in one of the commercially available X-ray developers.

Since all photographic materials are sensitive to X- and gamma radiation (*8–10, 14*), films other than those named in the literature may occasionally be used. It should be remembered, however, that visible-light speed is not an indication of gamma or X-ray speed. When choosing film, one must also consider the safelights under which processing will be done and the film's durability under handling.

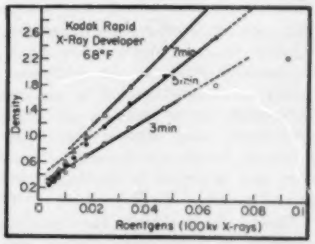

FIG. 3. Density vs exposure curves for Kodak No-Screen X-Ray Film developed for various times. Density range over which a linear relation exists depends upon development

Processing Considerations

If calibration films can be developed with each batch of monitoring films, many difficulties due to errors in processing will be avoided. However, if, by the nature of the operation, calibration films can be used only occasionally or not at all, extreme care must be exercised in maintaining constant all of the developing conditions.

It is safe to say that the most important requirement in quantitative measurements of radiation by means of photography is the processing of the exposed film. The degree of development, and hence the density obtained, depends on the time of development, the temperature of the developer, its degree of exhaustion, and the amount of agitation. The effects of these factors, if unrecognized, may lead to serious positive or negative errors in photographic dosimetry.

The curves shown in Figs. 2–6 are not intended as correction curves, but merely indicate the magnitude and direction of errors associated with departures from normal development conditions.

Figure 2 shows a group of characteristic curves of a typical X-ray film. The curve shape is typical of many of the films used in radiation monitoring. Such a curve of density vs log relative exposure is that most widely used to represent the exposure response of

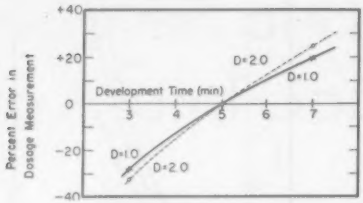

FIG. 4. Effect of errors in development time

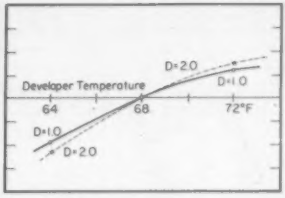

FIG. 5. Effect of errors in development temperature

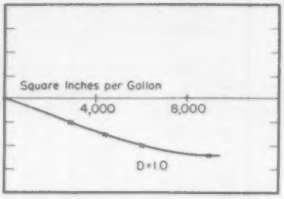

FIG. 6. Effect of exhaustion of developer

photographic materials. When the exposure is to X- or gamma rays, the abscissa values may be expressed in log roentgens, as in Fig. 2. The curve shape is independent, for practical purposes, of the wavelength of the exposing X- or gamma rays.

Many films, particularly direct-exposure X-ray films, have a linear relation between density and exposure over a limited density range (Fig. 3). Such a linear relation, if it is known to exist, may decrease the arithmetical work involved in radiation monitoring. However, before using such a relationship, preliminary tests should be made, since the degree of approximation to a straight line and the range of density over which it exists are a function both of the photographic material and of the development technique (*15, 16*).

Figures 2 and 3 show the results obtained when Kodak No-Screen X-Ray Film is developed for times of 3, 5, and 7 minutes in a typical X-ray developer for which the normal development time is 5 minutes. Note that the characteristic curve becomes slightly steeper and shifts to the left as development is increased.

Figure 4 shows the magnitude of the errors in dosage measurement that are introduced by errors in development time. The errors shown are based on exposures which would give densities of 1.0 and of 2.0 if the film were given normal development, i.e., 5-minute development in fresh developer at 68° F. Not only is an error in dosage measurement produced by an error in development time, but the magnitude of the error depends upon the density. Therefore, no single correction factor can be applied to adjust results to a standard development time. The uncertainty introduced by assuming a straight-line relationship between density and exposure over the full density range would be even greater.

Changes in characteristic-curve shape and location similar to those caused by changes in development time are produced by changes in the development temperature. Figure 5 shows the magnitude of the errors in dosage measurement introduced. Incidentally, it is a good idea to run calibration films with the first batch of monitoring films processed after one has broken the darkroom thermometer and replaced it with a new one!

As a developer is used, its activity decreases because the developing agents are being depleted and concentration of reaction products is increasing. Figure 6 shows the variation encountered as the developer is progressively exhausted. In the case shown, the films were exposed to a relatively low density, and the developer carried out of the tank by the film was replaced with fresh developer. It is difficult to give quantitative data on the effects of exhaustion, since they depend on the average density of the developed film, the carry-out of developer by the processed films and their hangers, and the manner in which this loss of developer is replaced—whether by fresh developer or by a replenishing solution. An additional factor to consider is that developers deteriorate upon standing in open containers, even without use. The errors in dosage measurement, therefore, may be greater or less than those shown here.

During development, the reaction products of development diffuse out of the emulsion layer and, in still development, produce a layer of partially exhausted developer at the film surface. Agitation of films or of developer during development will tend to sweep away this surface layer and allow fresh developer access to the film surface. Continuous agitation is not necessary—10 seconds' hand agitation by shaking, moving, or lifting the film hangers every minute during development is usually satisfactory. Agitation should be such as to produce turbulent, rather than streamline, flow.

Although this discussion has, of necessity, dealt with the precautions required in film monitoring of radiation, it should not be overlooked that the photographic method is inexpensive and convenient. The equipment which must be carried by personnel is small, light, and can be made very rugged. The record of the exposure received is permanent. By proper consideration of the requirements of the individual cases, film monitoring can often give quantitative results.

* * *

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Evaluation of Alpha-Particle Absorption by Filter Paper

Protection of workers requires air monitoring when uranium is used. Absorption by the sample-collecting filter makes a 30% correction necessary in counting

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BECAUSE OF THE POSSIBLE HAZARD from inhaled uranium compounds, the Health and Safety Division of the New York Operations Office and its contractors routinely monitor the air of uranium processing plants. Samples are taken on 1½ in. Whatman No. 41 papers, and while the uranium content of these papers can be determined chemically, a counting procedure is more rapid and economical.

The preferred maximum level of 50 $\mu g/m^3$ of air can be shown to be equivalent to 70 dpm/m^3. With low-background alpha scintillation counters having a geometrical efficiency of 40%, the 70 dpm should yield a net count of about 30 cpm. In practice, approximately 70% of this count is realized. The difference has been assumed to be due to absorption of the alpha particles by the filter paper.

Experimental Procedure

The experimental work for this paper was designed to evaluate the alpha absorption by comparison of counting and chemical analyses on actual plant samples. Routine samples are counted to a precision of ±20% at the 90% confidence level. The samples for this study were counted to approximately ±1% precision.

The procedure followed was simple. After analysis by counting, the samples were ashed in platinum crucibles, the residue dissolved, and the solution analyzed fluorimetrically.

The desired relationship was obtained by determining the slope of the line comparing cpm per sample with micrograms of uranium per sample, using the method of least squares. The absorption may then be obtained by converting cpm to micrograms of uranium on the basis of counter geometry and the 50/70 equivalence.

Two insoluble uranium compounds, U_3O_8 and UF_4, and the gas UF_6 were tested. The UF_6 hydrolyzes rapidly with the moisture of the air to form UO_2F_2, which is collected on the paper as a finely divided mist.

The range of uranium concentrations was selected to vary from a fraction of a microgram to over a milligram of uranium per sample. Where possible, least-square lines were calculated for sections of the curve as well as for the total. The results are shown in the table.

Conclusions

Dust or mist penetration. The loss in efficiency of the counting procedure is apparently due to the penetration of the paper by the dust or mist.

Mist vs solids. The penetration of the paper by mist is more marked than that by the solid uranium compounds.

Relative absorption. The relative penetration, and consequent alpha absorption, decreases as the amount of dust collected on the paper increases.

Self-absorption. No evidence of self-absorption by the uranium or inert dusts was found. This is not unexpected, as the amount of dust required for complete absorption would be about 35 mg per paper. This amount is never approached in practice.

Absorption factor. The use of an over-all correction factor of 30% for absorption is justified for routine counting.

* * *

This article is based on a paper presented before the Radiation Division, American Industrial Hygiene Association, Cincinnati, Ohio, April 24, 1952.

Results on Absorption of Uranium-Sample Alpha Particles by Filter Paper

Compound	*Number of samples*	*Micrograms of uranium*	*Absorption (%)*	*Relative standard deviation (%)*
U_3O_8	21	0.2–12	41	24
	27	20–1,800	27	19
	48	All samples	27	23
UF_4	23	2–250	37	21
	13	250–1,100	20	14
	11	over 1,100	15	11
	50	All samples	28	18
UO_2F_2	32	3–500	42	28

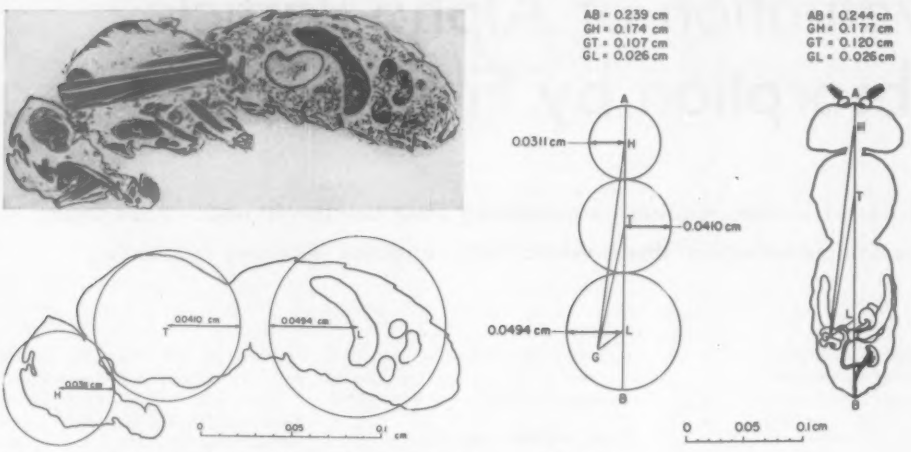

FIG. 1. Geometrical conditions used for determining radiation dose to male gonad

Calculation of Radiation Doses to P^{32}-Labeled Male *D. melanogaster*

By R. C. KING
Biology Department
Brookhaven National Laboratory
Upton, New York

One difficulty encountered in studies of biological effects involving radiophosphorus pertains to the calculation of the amount of ionization in tissue produced by the P^{32} electrons originating from decaying P^{32} atoms within tissue. This article describes the method used in calculating the geometrical factor necessary for determining the radiation dose absorbed by the gonad of the male of *Drosophila melanogaster*.

Consider a model of a male fruitfly consisting of three spheres of water equal in weight to the head, thorax and abdomen (see Table 1). The average weights of the three regions were obtained by weighing separately the heads, thoraxes and abdomens of 30 males and averaging the results. Assuming that radiophosphorus atoms are distributed in a homogeneous fashion in each sphere, the mean path, p_m, of an electron leaving a sphere will be ¾ the radius of the sphere (*1*). This assumes that the particle is travelling in a straight line. That such an assumption is warranted follows from the fact that the values for p_m in the table are all less than 0.095 cm. The length of the path of an electron of a given energy which is traversed before the electron may be considered to be wandering about in a random fashion is defined as s_D. Zumwalt has calculated the value of s_D for P^{32} radiations to be 142 mg/cm² in aluminum (*2*). The actual average penetration of a P^{32} electron in the straight part of its path is at least $\frac{2}{3}s_D$, or 0.095 cm in water. Equations for the geometrical factors giving the fraction of the energy dissipated by electrons from an internally decaying radioisotope which is absorbed in various regions of a sphere are (*3*).

Properties of Body Regions

Body region	Weight (mg)	Radius of sphere (cm)	p_m (cm)	F_A
Head	0.126	0.0311	0.0233	0.086
Thorax	0.289	0.0410	0.0308	0.113
Abdomen	0.505	0.0494	0.0371	0.139
Total	0.920	0.0604	0.0453	0.165

$$F_A = 1 - e^{-\alpha p_m}$$
$$F_C = 1 - e^{-\alpha x}$$
$$F_S = \frac{2\alpha x - 1}{4\alpha x} + \frac{1}{4\alpha x} e^{-2\alpha x}$$

where F_A gives a factor for the average absorption in the sphere, F_C is the factor for the center of the sphere, F_S the factor for the surface of the sphere, x is the radius of the sphere in cm, and α, the mass absorption coefficient, is equal to μ/γ. The apparent absorption coefficient, μ, is equal to 4 cm²/gm (*4*) and the density, γ, is 1 gm/cm³.

Studies on the distribution in tissue of labelled phosphorus assimilated during a 24-hour period by freshly hatched male fruit flies have demonstrated that the head, thorax and abdomen of the flies contain 9.7%, 33.1% and 57.2% respectively of the total P^{32}. From these data and the F_A values already determined, one can calculate that 0.84%, 3.74% and 7.97% of the energy dissipated by beta particles produced from disintegrating P^{32} within the male is absorbed in the head, thorax and abdomen respectively. Therefore, the total absorption amounts to 12.55%.

Figure 1 shows the geometrical conditions used for determining the radiation dose to the testis itself. It can be seen that spheres of water equal in weight to the three body divisions do form fairly good approximations of the actual conditions. The abdomen is more like an oblate spheroid than a sphere, but Lind (*1*) has concluded from the use of graphical methods that the average path of a particle in a cylindrical figure (in which the length does not exceed the diameter by more than a few fold) is approximately equal to the average path of the particle in a sphere of equal volume.

Calculation of F_T, the geometrical factor giving the radiation dose at the testes, is made possible through calculations by Rossi and Ellis (*4, 5*) from which a graphical representation is made of the relation of dose as a function of distance from the center of radioactive spheres having various radii. Let *GL* be the radius of a sphere intercepting the central portion of the testicular tissue, where the point *G* lies in the center of the helically coiled region of the testis. Then *GH*, *GT* and *GL* will give the distances from the center of the head, thorax and abdominal spheres to point *G*. These distances and the values for the radii of the three spheres are converted into multiples of $1/\mu$ (i.e. 0.25). The distances *GH*, *GT* and *GL* are read off on the *x*-axis, the appropriate curve chosen for the sphere in question, and the factor for the dose to the gonad read off on the *y*-axis. F_T is then given by the product of this value and the decimal describing the fraction of the total activity of the fly in that sphere.

After the calculations were carried out it became apparent that the radiation contributed to the testes by the head and thorax spheres is roughly $\frac{1}{10}$ that contributed by the abdomen. It is therefore so small as to be negligible. Figure 2 gives the dose factor at all points between the center and the surface of the abdominal sphere. F_T will equal the product of the dose factor chosen and 0.572. Calculation shows F_T to equal 0.0955.

These calculations, although very crude, seem justifiable as a beginning. The consideration of the abdomen as a sphere of water containing P^{32} distributed homogeneously seems especially attractive, since under the experimental conditions described it can be demonstrated that the abdominal haemolymph contains 62% of the total P^{32} in the abdomen.

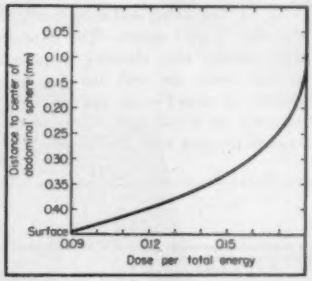

FIG. 2. Dose factor to all points between center and surface of abdominal sphere

The calculated total absorption of beta-particle energy by the fly amounted to 12.55%. Ignition of male *Drosophila* at 600° C reduces the flies to a fine white ash and leads to a 97-fold reduction in weight. Counts made with a restricted-atmosphere proportional counter are 9.5% higher than those counts determined for the same flies before ignition. One can conclude that the counting losses due to absorption are corrected in part by increases from back-scattering.

The calculated absolute values for the radiation dose to the gonad can be checked in the case of *Drosophila melanogaster*.

* * *

The author is indebted to Prof. D. F. Poulson and Dr. V. T. Bowen for their patient supervision of this work, and to D. W. Calhoun for valuable aid in the solution of certain mathematical problems. Part of the research was carried out at BNL under AEC auspices, while the rest represents a portion of a dissertation presented for the degree of Ph.D. at Yale University during the tenure of a Public Health Service Predoctorate-Bachelor Research Fellowship from the National Cancer Institute.

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4. H. H. Rossi, R. H. Ellis, NUCLEONICS **7**, No. 1 18 (1950)
5. H. H. Rossi, R. H. Ellis, NUCLEONICS **7**, No. 2, 19 (1950)

Vacuum Sealing Irradiation Containers by Cold Welding

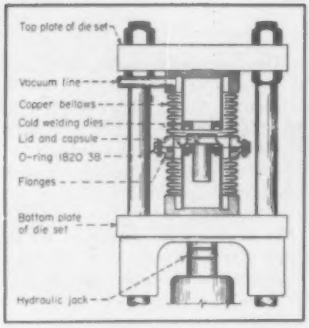
By P. B. AITKEN
Chemistry Branch
Atomic Energy of Canada Limited
Chalk River, Ontario, Canada

Cold pressure welding has been used at the Chalk River Project to seal capsules containing material for irradiation in the reactor.* A useful application of this technique is the method we have developed for sealing capsules in vacuum, or with special gas fillings.

The procedure† is first to degrease the parts to be joined, remove the oxide layer with a steel wire brush, and then squeeze them together with a suitable press and die so as to reduce the thickness by about one half, when welding takes place. The method works well with commercial aluminum and copper, and particularly well with super-pure (99.99+%) aluminum. The latter is used for our capsules because

* P. B. Aitken, *Rev. Sci. Instr.*, **22**, 709 (1951)

† Patents covering the use of this process have been taken out by the British General Electric Co.; Koldweld Corp. of New York, and General Engineering Co., of Toronto are licencees of the process in U. S. and Canada.



DIES AND ENCLOSURE for vacuum sealing

it has a low residual activity after irradiation.

The apparatus for vacuum sealing is shown in the illustration on this page. It consists of a 10-ton laboratory hydraulic press, on which are mounted the cold welding dies. Outside the dies are copper bellows, attached to the top and bottom die plates and sealed together with flanges and an O-ring seal. The bellows together with the top and bottom plates form a vacuum-tight enclosure which is evacuated by a suitable pumping system through a ½-in. diameter copper tube in the top (stationary) plate.

In use, the O-ring seal is broken and the dies moved apart. The capsule with sample, after cleaning, is placed in the lower die and the lid, also cleaned, is placed in the springs which hold the lid about ½-in. clear of the capsule to allow easy flow of gas from the capsule during evacuation. The dies are then moved together until the sealing flanges meet and are bolted together; at this stage the dies are still ½-in. apart. The system is then evacuated. When the required vacuum has been reached, the capsule is sealed by application of necessary pressure. As the dies move together the lid is pushed out of the spring clips and onto the capsule flange and sealed.

A vacuum of 10^{-4} mm Hg is readily obtained with this equipment, and there has been no evidence of leakage. Space was allowed in the design for installation of heaters should they be required for quickly outgassing the capsule before sealing. Test capsules sealed by cold welding normally withstand 500 lb/in.² internal pressure before bursting.

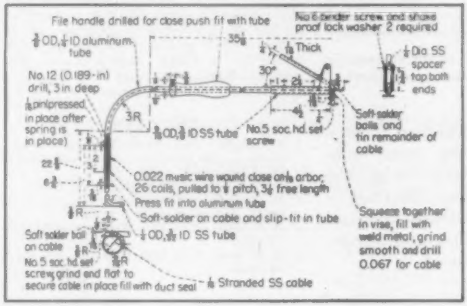

File handle drilled for close push fit with tube
No 6 binder screw and shake proof lock washer 2 required
⅛ OD, 1/16 ID aluminum tube
35/16
⅛ Thick
⅛ Dia SS spacer tap both ends
No 12 (0.189-in) drill, 3 in deep
30°
(pin pressed in place after spring is in place)
3R
⅛ OD, ⅛ ID SS tube
No 5 soc hd set screw
Soft-solder balls and tin remainder of cable
0.022 music wire wound close on ⅛ arbor, 26 coils, pulled to ⅛ pitch, 3½ free length
Press fit into aluminum tube
Soft-solder on cable and slip-fit in tube
Soft solder ball on cable
⅛ OD, 1/16 ID SS tube
No 5 soc hd set screw, grind end flat to secure cable in place fill with duct seal
⅛ Stranded SS cable
Squeeze together in vise, fill with weld metal, grind smooth and drill 0.067 for cable

FIG. 1. Snare-type handling device

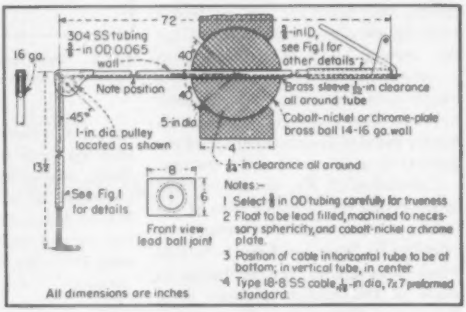

72
304 SS tubing ⅛-in OD, 0.065 wall
16 ga.
40
⅛-in ID, see Fig 1 for other details
Note position
Brass sleeve ½-in clearance all around tube
45°
1-in dia pulley located as shown
5-in dia
Cobalt-nickel or chrome-plate brass ball 14-16 ga wall
13
½-in clearance all around
See Fig 1 for details
8
6
Front view lead ball joint
Notes:-
1 Select ⅛ in OD tubing carefully for trueness
2 Float to be lead filled, machined to necessary sphericity, and cobalt-nickel or chrome plate.
3 Position of cable in horizontal tube to be at bottom; in vertical tube, in center
4 Type 18-8 SS cable, 1/16-in dia, 7x7 preformed standard.
All dimensions are inches

FIG. 2. Special hinge for snare-type handling device

Snare-Type Handling Device

By J. R. FARMAKES*

Radioisotope Development Department
Oak Ridge National Laboratory
Oak Ridge, Tennessee

Most of the operations involving radioactive materials require the use of remotely controlled devices that are not generally available. One of the most common tasks is the handling of cylindrical containers behind shielding barricades or inside shielded cells. It is extremely important that these operations be done safely and precisely. A dropped container can be hazardous to personnel and costly from the standpoint of spilled products and the necessity of decontaminating the equipment.

A survey of tongs available at this site revealed that for certain manipulations the known devices had one or more of the following disadvantages: (1) complex mechanisms, fragility, and poor reliability; (2) high cost of fabrication, maintenance, and repair; (3) excessive weight and clumsy operation; (4) poor decontaminability; (5) insecure gripping of containers: and (6) tong finger pressures too high and unbalanced.

To overcome these disadvantages, the unit shown in Fig. 1 was designed and fabricated for handling 200-ml bottles behind a 6-ft-high lead barrier. This tool is simple, lightweight, and therefore easy to handle. Also, the cost of materials and fabrication is low. The stainless-steel snare exerts uniformly distributed pressures on the contact surface of the container and provides a very firm and safe grip. Most of the elements of the unit can be easily decontaminated; where this is not possible, the parts can be replaced economically.

With simple changes in design, this tool can be made to handle other sizes of containers and to work over or around various types of barricades and

* PRESENT ADDRESS: Chemical Engineering Division, Argonne National Laboratory, Chicago, Ill.

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through slotted openings. Some of its limitations are: (1) the top of the container must be accessible; (2) without redesign of the actuating lever, large variations in loop diameter are impossible; and (3) for maximum safety in gripping, the containers should have a flange at the top edge.

For the more specialized problem involving the handling of containers inside a shielded cell, a common procedure is to use tongs through a slot. This introduces radiation hazards, especially with high levels of radioactivity. If the tongs are inserted through a ball and socket joint to overcome this, a vertical position cannot be maintained to lift a container in or out of a carrier or other shield.

The special hinge that is shown in Fig. 2 maintains the vertical position with the snare described here and still provides for adequate shielding. The hinge axis is located on the center line of the cable that is carried in the horizontal arm at the point of intersection with the center line of the cable in the vertical arm. The two sections of the cable are tangential to the pulley and in contact with it over 90-degrees.

In normal use, this arrangement of hinge and pulley results in the exertion of minimum moments on the lower arm. The moment developed by cable tension required to grip a container is essentially zero when the two arms are at right angles. For other angles, the combined weights of the lower arm and a very small load are more than sufficient to offset the tendency to cause deflection of the lower arm from vertical. A 10-lb cable pull causes practically no deflection of the lower arm when holding an empty 200-ml bottle.

Colloidal Chromic Radiophosphate in High Yields for Radiotherapy

By M. E. MORTON

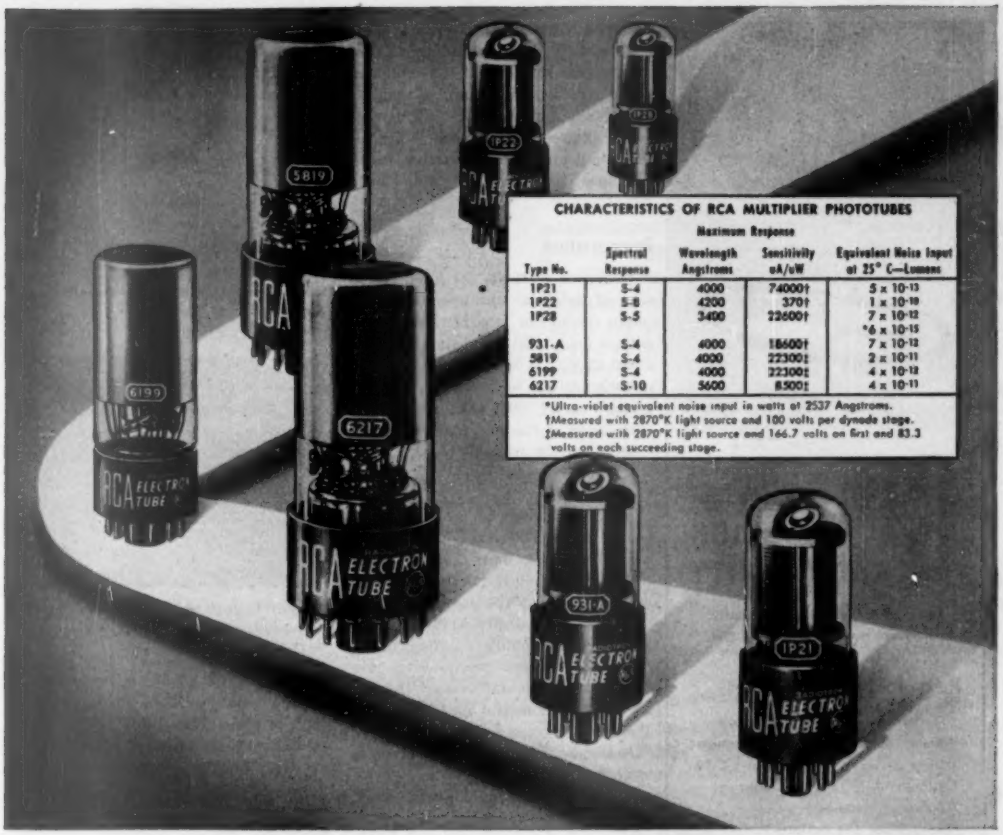
Radioisotope Unit
Veterans Administration Hospital
*Long Beach, California**

Interest is increasing in the use of colloids of radioactive materials in the therapy of neoplasms. Hahn and co-workers (*1, 2, 3*) have used Au^{198} in colloidal form in interstitial, intraperitoneal and intravenous routes of administration. However, Jones and co-workers (*4*) as early as 1944 demonstrated the use of P^{32} in a chemically inert colloidal form, chromic phosphate, for the irradiation of tissues of the reticuloendothelial system. This substance was also used interstitially in mice (*5*) in therapy of mammary adenocarcinoma with apparent good results.

Radioactive phosphorus, with its half-life of 14.3 days and its disintegration via emission of beta rays with a maximum energy of 1.7 Mev, seems to have many advantages over radioactive gold. First, radioactive phosphorus is essentially a pure beta emitter (*6*); hence, handling is more simple and safe than with radioactive gold. Au^{198} decays with a 2.7-day half-life emitting 0.95 Mev beta rays accompanied by 0.74 Mev gamma rays (*7*). The gamma rays of radioactive gold contribute little or not at all to the irradiation of the tissues under treatment but do constitute a distinct radiological hazard to the physician and other personnel handling the Au^{198}. Another disadvantage of Au^{198} colloids is the short half-life of the radioisotope. Since preparation of the colloid takes some time, the additional time necessary in shipping the colloid to distant centers for therapeutic use results in losses of much of the original material simply through radioactive decay.

Radioactive phosphorus, on the other hand, does not suffer the disadvantage of rapid radioactive decay. Its longer half-life permits preparation of the colloidal chromic phosphate and storage for use as needed. Because of the longer half-life of P^{32}, considerably smaller doses than in the case of Au^{198}, (1/5 to 1/10) in terms of millicuries, are equivalent in total ionizing

* Also, Department of Biophysics, School of Medicine, University of California, Los Angeles, Calif.



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				*6 x 10-15
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5819	S-4	4000	22300‡	2 x 10-11
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6217	S-10	5600	8500‡	4 x 10-11

*Ultra-violet equivalent noise input in watts at 2537 Angstroms.
†Measured with 2870°K light source and 100 volts per dynode stage.
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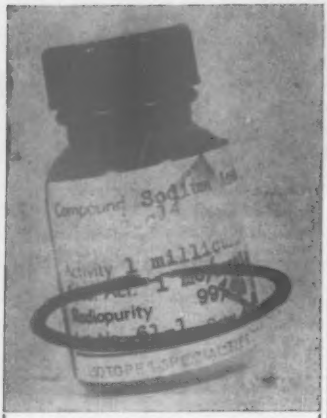

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radiation ultimately delivered. These reasons, as well as the finding (*5*) that its longer half-life allows colloidal chromic radiophosphate to accumulate in regional lymph nodes in amounts sufficient to produce significant irradiation, indicate this radioactive material may displace Au^{198} colloids in radiotherapy.

Preparation

Published methods (*4*) for preparation of colloidal chromic radiophosphate result in considerable losses with a final yield approximating only about 25%. It is the purpose of this communication to present a method giving a nearly 100% yield of a colloidal suspension of chromic phosphate, calculated on the basis of the P^{32} used, with particles in size ranges from 10 mμ to 2μ.

The major losses in previous methods of preparation of colloidal chromic radiophosphorus were due to incompleteness of precipitation, losses in utensils, and in the washing of the precipitate of hydrated $CrPO_4$ crystals. Since a single container is used in the entire process and precipitation procedures are made unnecessary through use of stoichiometric amounts of reagents, such losses are prevented.

Method. The following method is used in preparation:

1. Prepare an approximately 0.1*M* phosphoric acid solution and titrate with standard sodium hydroxide to the phenolphthalein end point.

2. Prepare an approximately 0.1*M* chromic nitrate solution and standardize with persulfate iodimetry.

3. To a 60-ml Pyrex bottle with ground-glass stopper add 1.95×10^{-4} moles of the standardized phosphoric acid solution.

4. Add the radioactive phosphorus as received from Oak Ridge (in acid solution). Mix, and add 2.00×10^{-4} moles of the standardized chromic nitrate solution.

5. The mixture is then evaporated to dryness under an infra-red lamp. When drying is complete, the bottle is placed in a furnace and left overnight at 500° C.

6. After cooling, the bottle is removed from the furnace and sufficient ¼-inch stainless-steel balls are added to make it one third full. Next 2.0 ml of pyrogen-free distilled water are added. The bottle is then stoppered and placed on the rolls of a small ball mill. Grinding for 1 day results in particles less than 1 micron in diameter

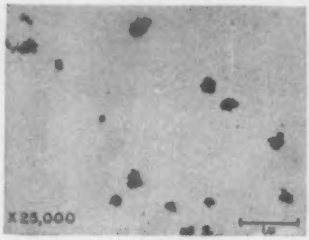

FIG. 1. Electron photomicrograph of particles of chromic radiophosphate after one day of grinding

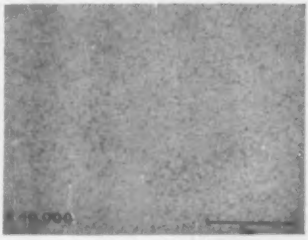

FIG. 2. Electron photomicrograph of particles of chromic radiophosphate after four days of grinding

(Fig. 1). Continuous grinding for 2–3 days produces particles as small as 10 millimicrons in diameter as measured by the electron microscope (Fig. 2). Thus, particles of almost any desired size range can be made by varying grinding time. Samples with particles ranging in size from 20–150 mμ, when dialysed in Visking sausage skin for prolonged periods against tap water, show no loss of radioactive phosphorus.

7. After autoclaving, dilution with sterile saline may be carried out. Hyaluronidase may be added to promote diffusion when interstitial injections are made. Epinephrine may be also used to produce local vasoconstriction. A suspending agent, such as gelatin, is necessary only for suspension of coarse particles, a micron or more in diameter.

Therapeutic Evaluation

Animal studies to be described elsewhere demonstrate the chemical inertness of colloidal chromic radiophosphate prepared in the fashion described in this communication. In addition, *in situ* measurements of bremsstrahlung or biopsies made after interstitial injection indicate negligible loss of radioactivity from the injected site, other than that due to the radioactive decay of P^{32} and some migration to

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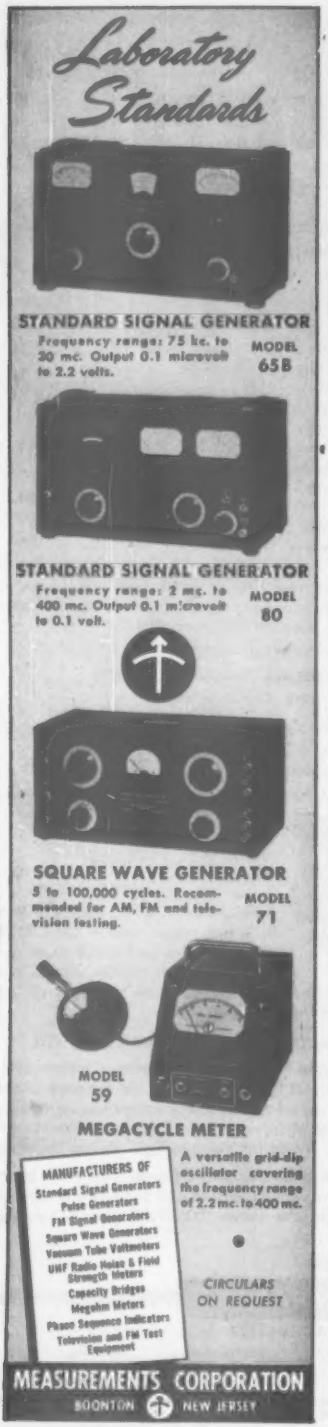
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regional lymph nodes. Also, after interstitial, intraperitoneal, intrapleural, and intrapericardial injection no significant appearance of P^{32} in blood, liver, kidney, urine, spleen, or bone marrow has been noted. The material has advantages even in topical beta-ray therapy in that ointments containing the colloid are more readily removed from the skin following the irradiation period, leaving no residual contamination as occurs when soluble phosphates are used. Data supporting these conclusions will be reported in a later communication.

* * *

Grateful acknowledgement is made to Carl Buchholz, Lee Starrett, and Dean Gamble for technical assistance, and to Dr. R. Baker and Roger Moore for electron microscopy. The radiophosphorus used was supplied by Oak Ridge National Laboratory on authorization from Isotopes Division, U. S. Atomic Energy Commission.

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Short-Lived Radioactivity; Correction for Long Counting Periods

By ROBERT H. SCHULER
Department of Chemistry
Canisius College
Buffalo, New York

In working with short-lived radioactivity such as the 40-sec isomers of silver, Ag^{107*} and Ag^{109*}, and with moderately short-lived isotopes such as 18-min bromine, Br^{80}, and 25-minute iodine, I^{128}, it frequently becomes necessary to count the samples over a period of time that is comparable to the half-life of the isotope. This must be done to accumulate sufficient counts to give the measurement statistical significance.

In the interpretation of the average counting rate obtained by this method of measurement, the exponential decay of the activity must be considered. As the counting rate varies over the course of the measurement, a correction must be applied to the average rate when one refers to the instantaneous rate at any particular time during the course of measurement. This problem arises since counters do not directly measure the instantaneous rate of the decay process but rather only integrate the rate over a period of time. The rate is then determined either arithmetically as an average in the case of scaling instruments or electronically in the case of rate meters.

The integrated count is effectively given by

$$C = \int_{t_1}^{t_2} C_t \, dt \qquad (1)$$

where it is postulated that the radioactive decay process, which is discontinuous and statistical, is described in the limit by the continuous function C_t, the instantaneous counting rate at time t. In the case where the half-life of the decay is very long relative to the counting period, the instantaneous rate is substantially constant and the equation reduces to its usual form

$$C = C_t \, \Delta t$$

or

$$C_t = C/\Delta t \qquad (2)$$

However, in the case of short half-lives, the decay of the counting rate during the period of observation must be accounted for. By substituting the exponential law into the integral, the equation may be put in the form

$$C = C_{t_0} \, \Delta t [F_0] \qquad (3)$$

where C_{t_0} is the instantaneous counting rate at the start of the period of observation, and $[F_0]$ is a factor expressed by the relation

$$[F_0] = \sum_{i=0}^{\infty} \frac{(-\ln 2)^i n^i}{(i+1)!} \qquad (4)$$

where n is the number of half-lives over which the count has been taken, i.e.

$$n = \Delta t / t_{\frac{1}{2}} \qquad (5)$$

Except for extremely small values of n for which $[F_0]$ is practically unity, the series of Eq. 4 converges slowly and makes computations laborious.

An expression more easy to use is obtained if one integrates the rate expression over a period of time from $t - \frac{1}{2}\Delta t$ to $t + \frac{1}{2}\Delta t$. In this case, when one calculates the instantaneous rate at the mean time of measurement, the expression becomes

$$C = C_{t_m} \Delta t [F_m] \qquad (6)$$

where $[F_m]$ is given by

$$\begin{aligned}[F_m] &= \sum_{i=0}^{\infty} \left(\frac{\ln 2}{2}\right)^{2i} \frac{1}{(2i+1)!} n^{2i} \\ &= 1 + \left(\frac{\ln 2}{2}\right)^2 \frac{n^2}{3!} + \left(\frac{\ln 2}{2}\right)^4 \frac{n^4}{5!} \\ &\quad + \cdots \\ &= 1.00000 + 0.02002n^2 \\ &\quad + 0.00012n^4 + \cdots \qquad (7)\end{aligned}$$

This series is seen to converge very rapidly since the first, third, and other odd powers of n drop out. For values of n less than three, the first three terms give an accuracy of better than one part in a thousand and for n less than unity, the accuracy is better than one part in ten thousand.

From this, it is seen that if the counting period is less than one half-life ($n = 1$) the ordinarily used Eq. 2 will hold to within 2% as long as the counting rate is taken at the mean time. For normal observations ($n < \frac{1}{4}$) the correction is seen to be negligible. Since Eq. 7 is dependent only on n, it is seen that, as long as the counting period is constant, the correction factor $[F_m]$ may be neglected in making the usual semilogarithmic plot employed in determining the half-life of a single radioactive species from decay measurements. The net effect here is only a vertical displacement of the curve by a constant value.

In the case where measurements are to be made on species whose half-life is not known, the method of successive approximations can be conveniently used since the correction factor is not sensitive to the period of measurement.

• • •

The author wishes to acknowledge that Professor William H. Hamill of the University of Notre Dame originally pointed out the question of the validity of the mean counting rate for extended counting periods on short-lived isotopes.

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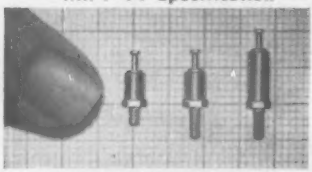

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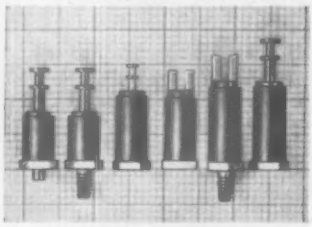

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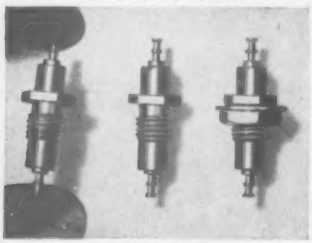

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Annual Review of Nuclear Science, Vol. 1 (1952)

Preparation sponsored by Committee on Nuclear Science of the National Research Council (Annual Reviews, Inc., Stanford, Calif., 1952, ix + 645 pages, $6). Reviewed by E. BRETSCHER, Head, Nuclear Physics Division, Atomic Energy Research Establishment, Harwell, England.

One of the most urgent problems with which modern science is confronted emanates from the flood of scientific information that is a consequence of the expansion of scientific research connected with the discovery of fission and the possibility of making use of the vast energies released in nuclear transformations.

The interest that government agencies have shown has provided large funds for research and, consequently, increased considerably the number of scientific workers. Such participation of the State has made possible such projects as big accelerators costing several million dollars; this was unheard of before the war and has permitted the carrying out of research into new and unexplored fields.

At the same time, the subject matter, originally confined to the attention of a few physicists, has, through its implications, attracted chemists, engineers, metallurgists, biochemists, biologists, sociologists, economists, and others. All this enormous expansion has brought despair to any true physicist who is not willing to restrict his attention to his own particular subject inside one of these fields, but who aims at what one would expect of a proper scientist, a broad and comprehensive view of the field as a whole. Many attempts are therefore made to present digests of the published literature, either as abstracts of papers or as reviews.

The first volume of the "Annual Review of Nuclear Science," just published, offers such surveys of the progress made as it appeared in the scientific press during the year 1950. The usefulness of such an undertaking depends entirely on the lucidity and the mastery of the subject matter with which the author can present his survey. It is quite unsatisfactory to give only an account of individual papers; something much more difficult is required—a thoroughly digested absorption of the material published during the period under review and a recast of it into such a shape that its relation with previous work becomes clear and that the advances during that period stand out. No hasty account dictated into a dictaphone can possibly suffice. The person most likely to succeed seems to be the scientist who is actively engaged in research in this particular field. Here one point springs to the eye insofar as this volume is concerned: Concerning the section on physics, nearly all the authors are acknowledged leaders in their respective fields.

The volume opens with R. E. Marshak's account (50 pages) of the present (1950!) state of *Meson Physics*. It is clearly written and apparently complete.

The *Recent Developments in the Theory of Nuclear Structure* (E. Feenberg) follows. For the experimental nuclear research worker, such a chapter is particularly important and valuable, since it concentrates and expresses in words what is often hidden in mathematical formulas in the original papers, and the experimental physicist does depend to a great degree on the didactic powers of the theoretical physicists, a gift extremely unevenly distributed among the theoreticians.

The contribution on *Nuclear Interactions of Cosmic Rays* (R. V. Adams) is not, in my opinion, concentrated enough (30 pages). It reads too much like an account of a long series of individual papers and is overloaded with details which are of secondary importance only.

An absolutely first-class contribution (30 pages), *Energy Levels of Light Nuclei*, comes from the California Institute of Technology, written by T. Lauritsen. Here is a manifest example of the ideal to be aimed at. In a few pages of introduction, various methods by which excited states of nuclei can be located and sometimes spectroscopically identified are explained. This is followed by a graphical, and therefore concise, presentation of the excited states of the nuclei up to sodium-20, often exhibiting similar nuclei such as fluorine-20, neon-20 and sodium-20 on the same page to permit comparison of the various level systems. A text associated with the figures supplements the information contained in the diagrams. We must all be grateful to the members of the Kellogg Radia-

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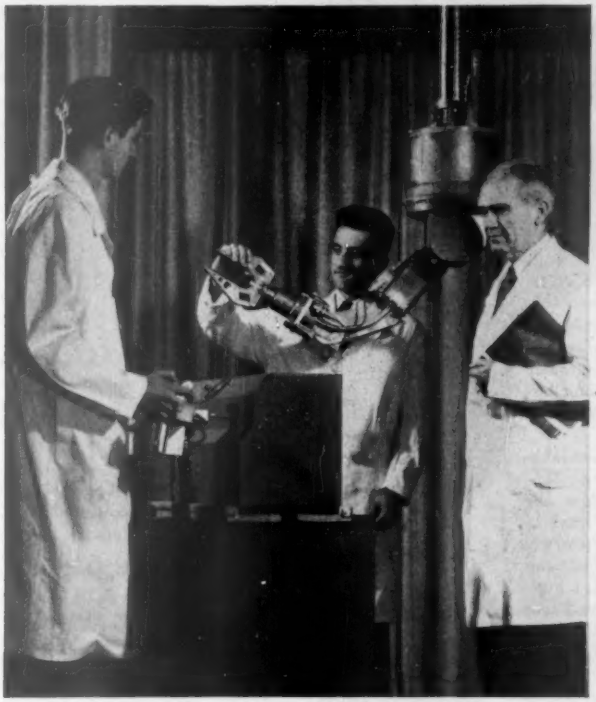

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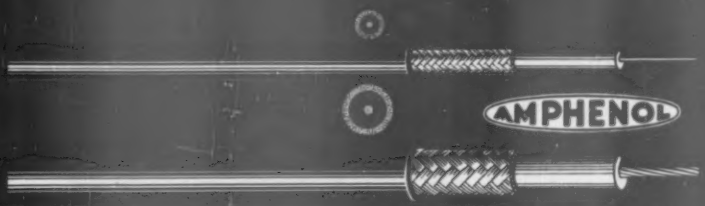

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tion Laboratory for this and other similar contributions which assist a great deal in the organisation of information in this part of nuclear physics. This quality is obviously brought about by the personal effort of the research physicist and could never be achieved by anybody who has not been associated with the subject during some of the best years of his life.

Anyone who knows N. Ramsey will expect his contribution on *Nuclear Moments* to be bright and imaginative. It is a pleasure to read it! Though it covers only 10 pages, the number of references runs up to 115, indicative of the rapid growth of this newly discovered field.

A. O. Nier contributes expertly on the *Mass and Relative Abundance of Isotopes*. The account of the inventive spirit of the physicists in thinking out new and better instruments is particularly attractive.

The partly unsatisfactory chapter on the *Electromagnetic Separation of Stable Isotopes* by C. P. Keim, of the Oak Ridge National Laboratory, leaves one with too many unanswered questions. The article (30 pages) insofar as the separation plant itself (6 pages) is concerned is obviously secrecy-inhibited. The rest deals with shipments and the uses of stable isotopes.

The *Chemical Separation of Stable Isotopes* is covered by G. H. Clewett (8 pages).

Five articles (89 pages) on *High Energy Accelerators* deal with standard cyclotrons, synchrocyclotrons, proton synchrotrons (by M. S. Livingston); synchrotrons (by J. E. Thomas Jr., W. L. Kraushaar, and I. Halpern); and linear accelerators (by J. C. Slater). One would wish that the High Voltage Corporation in Cambridge, Mass., had added their "success" story on high-voltage d-c machines: I am sure a good deal of tube redesign would have started in those laboratories not fortunate enough to be able to buy the real article.

The *Detection of Nuclear Particles* (33 pages), by W. H. Jordan, deals with the progress of scintillation counters, proportional counters, ionization chambers, and neutron detectors. Obviously, the author has had practical experience in this field and many of his remarks on the relative advantages and weaknesses of a particular design are worth studying. I can hardly believe the statement that the deuterium chamber for gamma-ray spectroscopy is equal to the pair method

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22 MR	3-26 KV	3 MA. at 20 KV	.5%
23 C	5-40 KV	1.3 MA. at 25 KV	.....
23 CR	5-40 KV	1.3 MA. at 25 KV	.5%
23 M	5-45 KV	1.5 MA. at 30 KV	.....
23 MR	5-45 KV	1.5 MA. at 30 KV	.5%
24 C	5-50 KV	1 MA. at 35 KV	.....

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in the resolution (see Kinsey's results).

Atomic and Molecular Spectroscopy, by G. H. Dieke, contains much interesting information (49 pages; 331 references), including the Retherford-Lamb shift and general spectroscopy, with special attention to the heaviest elements of mercury, diatomic molecules, microwave spectra, radio-frequency spectroscopy, spectra of solids and liquids, and spectrochemical analysis.

Helium (3) and superconductivity are reviewed by C. T. Lane (27 pages) in a chapter on *Low Temperature Phenomena*.

This completes the physics contributions which take up more than half of the volume. The remainder deals with chemical and biological materials.

The very informative article (24 pages) by B. A. Rogers and F. H. Spedding on the *Progress in Metallurgy* will be read with interest by all who wish to get an inkling of the intimate connection between metallurgy and reactor material problems. Radiation effects in solids are dealt with; the properties of thorium and uranium and of their alloys and some of the high melting uranium and thorium compounds are described; and the use of radioisotopes in metallurgical investigations is illustrated. The section on metals of actual and potential use in reactors and that on liquid metals suitable for efficient heat transfer are very valuable.

The chemical papers (75 pages) concern: *Isotopic Tracers in Chemical Systems* (R. R. Edwards), *Analytical Nuclear Chemistry* (C. J. Rodden), *Geochemistry* (M. Fleischer and J. C. Rabbitt).

The contributions (131 pages) in the biological field are: *Genetic Effects of Radiation* (R. F. Kimball), *Some Aspects of the Biological Action of High Energy Radiations* (H. M. Patt), *Radioisotopes in Biochemical and Medical Research* (C. A. Villee), *Stable Isotopes in Biochemical Research* (D. Rittenberg and T. D. Price) and *Radioisotopes in Soils Research and Plant Nutrition* (S. B. Hendricks and L. A. Dean).

An extensive author and subject index concludes the book.

One final remark: I wonder if a scientist interested in biology is willing to purchase 600 pages, of which only 130 pages are concerned with his field and the rest hardly accessible to him? I hope so, though much of the physics must be quite difficult for biologists to

assimilate. Physicists, I expect, will certainly be interested in the biological effects of radiation on their bodies if they are careless.

On the whole, it seems that a successful beginning has been made; the standard set by the first volume is worthy of the purpose and promising for future volumes.

OTHER LITERATURE

Atomic Energy Levels, Vol. II, by Charlotte E. Moore (National Bureau of Standards Circular 467), xxxi + 227 pages. This volume, the second part of a compilation of atomic energy levels derived from analyses of optical spectra, contains data on 152 spectra of elements with atomic numbers 24 through 41 (chromium through niobium); the previous volume, published in June, 1949, presented similar data on 206 spectra of the first 23 elements (hydrogen through vanadium). The general arrangement of Vols. I and II are identical. A brief explanation and a selected bibliography covering the analysis appear with each spectrum. Energy levels are tabulated in the related groups that form spectroscopic terms, starting with the lowest level as zero. Electron configurations are given; for the more complex spectra, arrays of observed terms are given also. Similar arrays of the terms predicted by theory for important isoelectronic sequences are included in the introduction. The text also lists errata and additions to Vol. I. *GPO, Washington 25, D. C., buckram bound, $2.25.*

35th Annual Report of the National Research Council of Canada (1951–1952). The many projects carried out in the Council's nine laboratory divisions are reported in this document, together with an outline of the year's activities in atomic-energy research at Chalk River which includes an account of the relinquishment of the atomic energy project responsibility from NRC to the Crown company, Atomic Energy of Canada, Ltd. *National Research Council, Ottawa 2, Canada.*

Harwell, the British Atomic Energy Research Establishment (1946–1951). A case-bound edition of this 128-page report (see NU, Sept. '52, p. 64) has just been published by *The Philosophical Library, 15 E. 40th St., New York 16, N. Y., $5.75.*

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NUCLEONIC EVENTS

University of Utah Gets OK to Design Low-Power Reactor; Private Funds Available for Construction

The second university-owned reactor in the country may be built on the campus of the University of Utah, Salt Lake City, with funds made available by the Kennecott Copper Corp. Final approval, when the plans are complete, must still be given by AEC.

Aside from fuel, the construction budget for the research device is $50,000. It is expected that the U^{235} fuel will be furnished by AEC under a provision calling for return of the fissionable material if defense needs warrant it.

Two other universities are also interested in building small research reactors with their own funds, and it is regarded as probable that they will get AEC approval. The first privately-owned nonsecret reactor is under construction at North Carolina State College, Raleigh (NU, Dec. '50, p. 5).

It is understood that there are other institutions interested in obtaining research reactors, but they are not sure of the availability of nonpublic funds for the purpose. Support of these reactors by AEC is an academic question at this time since the reactor division has no funds available for such uses. Any decision on AEC support for these reactors will have to wait until decisions for the next fiscal year are made.

The Utah reactor project will be under the direction of Lyle B. Borst, and will be a joint effort of many members of the university staff. The immediate objective is to construct a powerful and useful reactor at the lowest possible price.

Similar in design to the Los Alamos water-boiler, the reactor will have a core consisting of a 1-ft-diameter sphere of U^{235} in water solution. The chain reaction will be started by surrounding the core with a water reflector, and stopped by draining away the water.

The flux is expected to be half that of the Brookhaven reactor, which has a flux of 4×10^{12} n/cm²/sec. The shield will consist of $15 \times 15 \times 10$-ft concrete blocks.

The reactor will be housed in a two-story clapboard and frame former movie theater. The control room will be in the projection booth, and the external neutron beam will travel down a 200-ft corridor formerly used as the aisle of the theater.

Kennecott Copper expects to make use of radioisotopes from the reactor in studies of metals and elements present in its vast Bingham Canyon copper mines and adjacent tailings dumps.

The presence of a reactor in the area should help to overcome difficulties now encountered by western researchers due to the short half-lives of certain isotopes. The half-lives of C^{11} and the oxygen and nitrogen isotopes are so short, for instance, that they cannot be successfully shipped from AEC installations to western laboratories.

3 New Members Join AEC's General Advisory Committee

JOHN C. WARNER, EUGENE P. WIGNER, and JAMES B. FISK, who have been named to the general advisory committee of AEC

The General Advisory Committee of the Atomic Energy Commission, whose establishment was called for in the atomic energy acts of 1946, has released the first statement of its philosophy and method of operation. This announcement was made at the time of the appointment of three new members to the committee to replace three members who have served their statutory terms.

The new members of the committee are John C. Warner, professor of chemistry and president, Carnegie Institute of Technology; Eugene P. Wigner, professor of mathematical physics, Princeton University; and James B. Fisk, director of research in physical sciences, Bell Telephone Laboratories. They replace James B. Conant, Lee A. DuBridge, and J. R. Oppenheimer. The other members of the committee are Oliver E. Buckley, Willard D. Libby, Eger V. Murphree, John von Neumann, I. I. Rabi, and Walter G. Whitman.

The committee, which has no permanent staff, meets periodically to discuss questions that it thinks AEC should be concerned with or questions that AEC has asked it to consider. The committee looks to AEC as the source of information on which to base decisions. Recommendations are submitted to AEC in the form of a letter after each meeting.

Sometimes the committee considers matters which are not entirely technical. One reason it does this is that "technical development cannot prosper in the absence of general policy and of understood, if not always explicitly formulated, objectives." The other reason is that organizational and practical arrangements must be made if recommended technical policy is to be carried out.

As examples of such matters, the committee cites organization of AEC's development work on reactors, organ-

ization of AEC's research and development efforts in raw materials, need for weapons tests, creation of an informed general understanding of the prospects for civil power, objectives of the thermonuclear program, need for an accessible atomic proving ground, and the technical benefits to be derived from collaboration with the United Kingdom and Canada.

Commissioner Glennan Resigns From AEC

T. Keith Glennan, member of the five-man Atomic Energy Commission since August, 1950, resigned from that post last month. Glennan, whose term was to have run to June 30, 1955, will return to his position as president of Case Institute of Technology, Cleveland.

Students at ORSORT Session Represent 16 Companies

The third session of the Oak Ridge School of Reactor Technology (operated by Carbide and Carbon Chemical Corp.) has opened with a record enrollment of 80 students. The 12-month course is designed to equip the students to design and operate a reactor (NU, Feb. '52, p. 10).

Of the students, 31 are from universities in this country, and are student-employees of Oak Ridge National Laboratory. The remaining 49 are on loan from industrial organizations and various government agencies.

The companies represented by students at this session are: Aerojet Engineering Corp., American Gas and Electric Service Corp., Babcock and Wilcox, Blaw-Knox Construction Co., Boeing Airplane Co., Bonneville Power Administration, Consolidated Vultee Aircraft Corp., Duquesne Light and Power Co., Electric Boat Division of General Dynamics Corp., Foster-Wheeler Corp., Mine Safety Appliance Co., Monsanto Chemical Co., Newport News Shipbuilding and Drydock Co., Pratt-Whitney Aircraft Co., Sperry Corp., and Westinghouse Electric Co.

The curriculum has been expanded and the faculty increased over the first two sessions. Courses currently scheduled in the school include: reactor analysis, reactor engineering, health physics, nuclear physics, reactor materials, mathematics, chemistry, and experimental reactor physics laboratory.

At the second ORSORT session, 1951–52, students from the following companies attended: Allis-Chalmers Mfg. Co., Boeing Airplane Co., California Research and Development Co., Cities Service Research and Development Co., Douglas Aircraft Co., General Mills, Inc., Hercules Powder Co., Byron Jackson Co., Metropolitan Edison Co., Minneapolis-Honeywell Regulator Co. (Brown Instrument Division), National Lead Co., Public Service Electric and Gas Co., Reynolds Metal Co., Sinclair Refining Co., and Socony-Vacuum Oil Co.

The Editors Hear . . .

- Congress will be called upon to appropriate $3-billion more for atomic energy facilities, predicts Congressman Henry M. Jackson, member of the Joint Committee on Atomic Energy. In a statement to NUCLEONICS, he said, "This additional amount represents approximate figure of what we can actually do based on raw material supply. It also represents the sum of money that will give us a truly all-out program. The current expansion is only about half our actual capacity."

- Sentiment among all the commissioners of the AEC is to recommend to Congress that the Atomic Energy Act be changed to permit industrial ownership of nuclear power plants. One stumbling block to industrial participation in atomic energy which has not been mentioned in public previously is the fact that our agreements with our principal foreign suppliers of uranium stipulate that this uranium must be used only for the defense of the Western nations. Raw material from such foreign nations would thus not be available for a nuclear power industry.

- Industry should not invest in the atomic energy field until after the McMahon Act is changed—so says David E. Lilienthal, former chairman of AEC. Meanwhile, and as long as secrecy exists, he suggests that industry obtain AEC contract work and thus get behind the "uranium curtain."

- In an interview with NUCLEONICS, AEC chairman Gordon Dean said:
  - ➢AEC may not be able to guarantee a plutonium market to builders of industrial power reactors.
  - ➢It isn't wise for AEC to build a pilot power reactor such as has been proposed by some companies. He says that if AEC builds anything —and he says it should soon—it should be a full-scale power unit.
  - ➢The AEC commissioners are all agreed that at least one small "power package" (10,000–50,000 kw) reactor generating station should be built within the next year. Dean feels two such reactors should be built. He says they should be in remote, high-cost power areas at Government installations rather than private ones (this would seem to eliminate the proposal of the Eureka, Nevada, mining group—NU, Sept. '52, p. 66)
  - ➢The fact of the detonation of the British atomic bomb last month does not change matters as far as exchange of information between this country and England is concerned. However, Mr. Dean feels that if we are to be full military partners with England atomic energy information should be shared as part of such a partnership.

- Congress should permit the AEC to guarantee the price of plutonium for 25 years, according to Monsanto Chemical Co.

- Business done by nuclear instrument manufacturers has increased about 300% since 1949.

British Work on 3 Power Reactors, One a Breeder

British scientists at the Atomic Energy Research Establishment, Harwell, are working on a new reactor designed to produce power and breed

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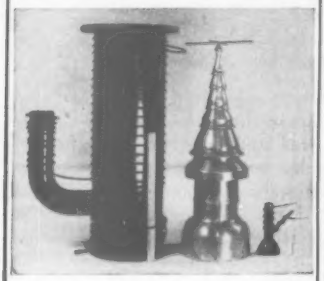

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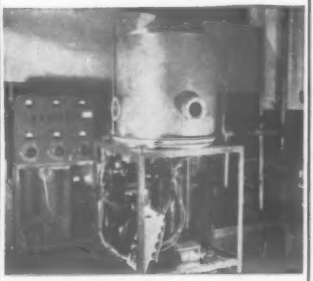

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secondary fuel. According to a statement by the British Supply Ministry, this breeder will make use of fast or intermediate neutrons.

Two other reactors are in the works at Harwell. One is a slow-neutron reactor using enriched-uranium fuel designed for special application such as ship propulsion. The other is a slow-neutron uranium reactor designed for generating electric power.

In disclosing the construction of the breeder, the Supply Ministry said that there is still much research work to be done and that it might be 10 years before economic possibilities are known.

Construction of Multi-Bev Accelerators is Made Feasible by New Strong-Focusing Principle

A new system of focusing particles in flight, worked out at Brookhaven National Laboratory by Ernest D. Courant, M. Stanley Livingston, and Hartland S. Snyder, brings into the range of economic and engineering feasibility the construction of accelerators that will deliver particles with energies as high as 100 Bev. It is expected that an accelerator based on this system will be built.

The focusing is done by magnetic fields as in present racetrack-design cyclotrons. But instead of having the field gradient in the same direction in all sections of the magnet, the direction of the field gradient alternates from section to section—the field increases towards the center of the cyclotron in one magnet section and increases towards the outside in the next section.

This alternation of converging and diverging forces is found to have a cumulative convergent effect, analogous to the convergence of light by alternating converging and diverging lenses. The convergence of the beam of particles is so strong that the vacuum chamber in which the particles travel can be made extremely small compared to the size of chamber necessary in large cyclotrons today.

For a 30-Bev accelerator, the vacuum chamber would only be about 1×2 in. in cross section; the chamber of the 3-Bev cosmotron is about 6×28 in.

With such a small chamber, the magnet could be made quite small. This is where the economic saving comes in. A 30-Bev machine would require a magnet half the weight of the 2,200-ton magnet of the 3-Bev machine. The magnet units of the cosmotron are 8×8 ft in cross section; magnet sections for a strong-focusing 30-Bev machine would only have to be about $1\frac{1}{2} \times 2$ ft in cross section.

The orbit diameter of a 30-Bev accelerator would have to be 10 times the 60-ft diameter of the 3-Bev cosmotron. The radiofrequency system for increasing the energy of the particles would also be more complex.

A 100-Bev machine with magnets of the same cross section could also be built, but the orbit diameter would have to be three times as large, or nearly half a mile.

The strong focusing system can also be applied to linear accelerators, and details of such application have been worked out by John P. Blewett of Brookhaven. Such a machine might be useful for injecting protons into a multi-Bev cyclotron.

2 Gaseous-Diffusion Plants Sign Power Contracts

Electric power for the Atomic Energy Commission's new gaseous-diffusion plant to be built in Pike County, Ohio (NU, Sept. '52, p. 67), will be supplied by a combination of 15 private power companies.

The combination, known as Ohio Valley Electric Corp., has contracted to supply 1.8-million kilowatts to the plant. To do this, two huge steam-electric plants, with a total capacity of 2.2-million kw, will be constructed. The agreement also calls for the availability of up to 465,000 kw for construction and early operation of the plant.

Under another contract entered into by AEC, a group of five private power companies, known as Electric Energy, Inc., will increase its supply of power to the Paducah, Ky., gaseous-diffusion plant. The total power to be supplied by this group has been raised from 500,000 to 735,000 kw, which represents 25% of the additional power required by the expansion program at the plant (NU, Sept. '52, p. 67).

The remaining 75% of the increased needs of the Paducah plant, 705,000 kw, will be supplied by the Tennessee Valley Authority. This will make the total supplied by TVA 1.2-million kw.

The annual cost of power for the Ohio plant will be about $60-million

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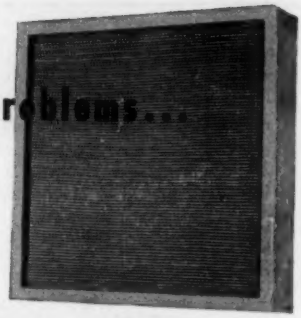

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when it goes into full operation four years from now. The Paducah plant, when it hits its full operation stride, will pay an estimated $23-million annually for private power, and $37-million for power from TVA.

Ohio Valley Electric Corp. is headed by Philip Sporn, president of American Gas and Electric Co. The other companies represented in the group are: Columbus and Southern Ohio Electric Co., Cincinnati Gas and Electric Co., Louisville Gas and Electric Co., West Penn Power Co., Potomac Edison Co., Monongohela Power Co., Ohio Edison Co., Pennsylvania Power Co., Toledo Edison Co., Appalachian Electric Power Co., Indiana and Michigan Electric Co., Kentucky Utilities Co., Dayton Power and Light Co., and Southern Indiana Gas and Electric Co.

The five companies comprising Electric Energy are Central Illinois Public Service Co., Illinois Power Co., Kentucky Utilities Co., Middle South Utilities, Inc., and Union Electric Co.

Eleven Companies Join Power-Reactor Study Group

Eleven companies have joined the power-reactor study program being conducted by Dow Chemical Co. and Detroit Edison Co. under an agreement with the Atomic Energy Commission. This is one of four groups conducting such studies (NU, June '51, p. 42).

The companies that have just joined the project are Cincinnati Gas and Electric Co., Cleveland Electric Illuminating Co., Consolidated Edison Co. of New York, Consumers Power Co., General Public Utilities Corp., New England Electric System, Philadelphia Electric Co., Public Service Electric and Gas Co. of New Jersey, Toledo Edison Co., Vitro Corp. of America, and Wisconsin Electric Power Co.

Babcock and Wilcox and Nuclear Development Associates have been associated with Dow-Detroit Edison as consultants since the start of the project.

Last April, AEC announced that it had accepted, in substance, a proposal by Dow-Detroit Edison for a jointly-financed program to develop a reactor for the production of both fissionable material and power. Most of the work by the two companies, estimated at about $275,000 in direct cost, will be carried out in their own laboratories. Research by AEC on the program will be carried out at the national laboratories at Argonne, Brookhaven, and

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Oak Ridge. Much of this work is already in progress or has been budgeted under AEC's power-reactor development program at about $725,000 in direct costs.

Radiochemical Processing Plant Almost Finished

The Idaho Chemical Processing Plant at the Reactor Testing Station, Arco, Idaho, which is to be one of the Atomic Energy Commission's major radiochemical processing plants, is nearing completion.

The process used was developed at Oak Ridge National Laboratory, and many intricate mechanical components and special instruments for the new plant were fabricated at ORNL. A team of ORNL engineers and American Cyanamid Co. personnel are now making preliminary chemical runs at the processing plant.

Bechtel Corp. is the construction contractor, and American Cyanamid is to be the operation contractor. Detail design drawings were made by Foster-Wheeler Corp. from preliminary design work done by the ORNL chemical technology division.

AEC Operations Office Established in San Francisco

A San Francisco office has been added to the eight existing operations offices of the Atomic Energy Commission. John Flaherty, assistant manager of the Chicago office, is manager of the new office.

The San Francisco area office, which has been reporting directly to the AEC production division in Washington, and the Berkeley area office, which has been under the Chicago office, are consolidated into the new office, which will report directly to Lawrence R. Hafstad, director, reactor development division.

AAAS Meeting to Include Sessions on Radioisotopes

The six-day meeting of the American Association for the Advancement of Science at St. Louis, Dec. 26–31, 1952, will have a full-day symposium sponsored by the Oak Ridge Institute of Nuclear Studies.

The topics and speakers for the morning session on radioisotopes in industry are *Survey of Industrial Applications of Isotopes*, Irving P. Orens, Newark College of Engineering; *Isotopes in Metallurgy*, H. Rush Spedden, Massachusetts Institute of Technology; *Prob-*

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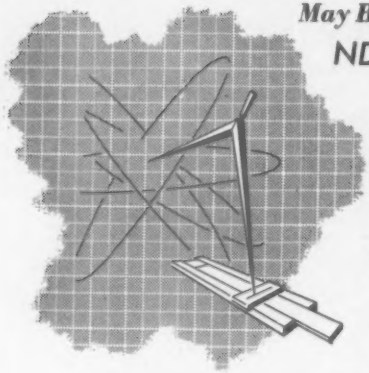

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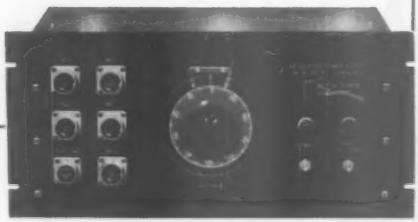

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lems of Industrial Participation in the Nuclear Science Program, William L. Davidson, Atomic Energy Commission; and *Survey of Industrial Reactor Proposals*, John Landis, AEC.

The afternoon session, devoted to research applications of C^{14}, will have papers on *Radiocarbon Dating*, *Radiocarbon in Organic Mechanism Studies*, *Radiocarbon in Biochemistry*, and *Radiocarbon in Photosynthesis*.

There will also be a conference on scientific manpower sponsored by the AAAS Cooperative Committee on Teaching of Science and Mathematics and the Engineering Manpower Commission. Other sessions of the meeting will be concerned with disaster recovery, magnetic resonance and its applications, astronomy, and geophysics.

RAW MATERIALS

• **Colorado.** A new process for treating uranium and vanadium ores is in operation at the Uravan mill of the U. S. Vanadium Co. Ores, containing as little as 0.1% uranium, are mixed with reagents and then roasted. After roasting, the mixture goes to leaching tanks in which the uranium and vanadium are dissolved by different solutions. Each mineral is then precipitated separately. The final step is shown in the picture below.

The process is believed to be the most efficient for recovery of the uranium and vanadium found in the carnotite ores of the Colorado plateau

URANIUM CONCENTRATE, extracted from the ore, is being scraped off filter presses at the Uravan, Colo., mill of the U. S. Vanadium Co. It will next be dried and packed in steel drums for delivery to AEC

which contain a high percentage of lime. It is expected that development of the process will result in a considerable expansion of mining activity throughout the area.

• **South Africa.** Six plants for extraction of uranium oxide are under construction in different localities in the Transvaal, with one of them scheduled for completion this month. During the first six months of this year, $19.6-million was invested in the country's uranium mines.

Thorium is also found in South Africa. The Anglo-American Corp. plans to produce 8,000 tons annually of a concentrate containing 55% of rare earths and thorium oxide. The entire output up to the end of March, 1956, has been sold, mostly to the United States.

• **Australia.** The U. S. Atomic Energy Commission is reported to have recommended a loan of $9-million to the South Australian government for large-scale uranium production at Radium Hill.

A 2,000-ft-long ore deposit, extremely rich in uranium content, has been found near Darwin.

The first major shipment of uranium ore from the Rum Jungle field has been loaded, and is believed headed for the United States.

IN BRIEF

• **New French reactor.** The second reactor in France, 20 miles south of Paris, was scheduled to be in operation at the end of last month. Known as P-2, the 1,500-kw, heavy-water reactor will be used for plutonium production.

• **Natural neptunium found.** The first trace of natural neptunium-237 has been discovered in ore from the Belgian Congo. Only three ten-billionths of an ounce of the isotope has been isolated from the pitchblende ore. The discovery was predicted in 1947 by Glenn T. Seaborg who pointed out that uranium-bearing ores behave, in miniature fashion, like reactors as far as the synthesis of byproducts is concerned.

• **Radioactive DDT.** Scientists at the Oregon experiment station of the Department of Agriculture have been using C^{14} as a tracer in DDT in an effort to find more effective ways of killing mosquitoes and other insects.

• **Norwegian reactor.** The reactor at Kjeller, Norway, has started round-

SOLID STATE PHYSICS

Cryogenic

- **Nuclear resonance experiments**
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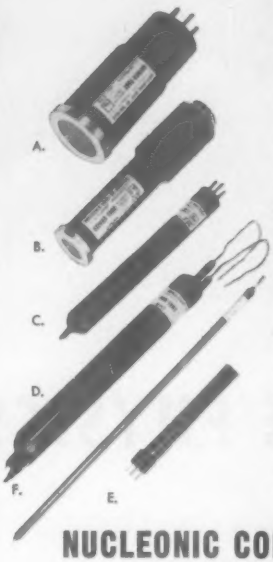

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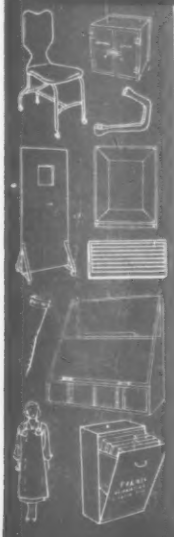

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the-clock operation. Contracts have been placed for isotopes for medical use, reactivation of Co^{60} for Norway's cancer hospital, and production of Co^{60} for industrial testing of steel.

NUCLEAR NEWSMAKERS

Henry A. Carlberg has been appointed manager of plant engineering of the manufacturing department at the Hanford Works.

Samuel C. Lind, acting director of the chemistry division at Oak Ridge National Laboratory, has been awarded the Priestly Medal, highest honor of the American Chemical Society.

Don S. Burrows has been appointed controller of the Atomic Energy Commission. He succeeds **Lindsley H. Noble** who resigned in May.

J. Russell Bright, professor of chemistry at Wayne University, has been appointed representative of his institution on the council of participating institutions of Argonne National Laboratory. Wayne University is the 32nd participating institution of the laboratory.

L. J. Laslett, professor of physics at Iowa State College, has received a year's leave of absence to serve as temporary head of the nuclear physics branch of the Office of Naval Research.

Philip S. Baker, associate professor of chemistry at Bradley University, has left to become head chemist, stable isotope research and production division, Oak Ridge National Laboratory.

W. J. Henderson, formerly of the nuclear physics group of the Canadian National Research Council, has joined the staff of Atomic Energy of Canada, Ltd.

A. Kennon Davis, instructor in physiology at the University of Tennessee Medical Units, has joined the staff of the U. S. Naval Radiological Defense Laboratory, San Francisco, to do research on thermal burns from an atomic explosion.

Carlos Graef Fernandez will be in charge of the second nuclear physics laboratory in Latin America which began operation at the University of Mexico in July.

Paul N. Rasmussen, a civil engineer, has been appointed director of the Division of Organization and Personnel, in the N. Y. Operations Office of the AEC. He replaces **L. Dale Hill,** who resigned the position.

New AEC Patent Releases

THE following patents, released by the Atomic Energy Commission, are available for royalty-free, nonexclusive licensing. Applicants should apply to the Chief, Patent Branch, Office of the General Counsel, U. S. Atomic Energy Commission, Washington 25, D. C. Patents should be identified by number and title.

Radiation-Measuring Instrument (2,601,583) C. O. Ballou—portable radiation detector capable of holding its calibration to 10% for prolonged periods under varying atmospheric conditions. Automatic space-charge limiting of the tube prevents destabilization and damage to cathode during warm-up period.

Pocket Ionization Chamber (2,601,637) J. E. Rose, E. W. Hinspater—hermetically sealed, low-leakage, readily charged, and easily read chamber consists of concentric cylindrical parts: outer contact element, sealed insulating casing, and rod-like inner electrode. Pressure-type means makes contact between electrodes; exterior of casing employs a flexible insulating diaphragm. Gaseous ionizing medium used within casing.

Method of Concentrating Isotopic Carbon (2,602,047) M. Calvin, J. W. Weigl—CO_2 is enriched in heavy carbon isotopes by action of chlorophyllic plant life in a closed system, while CO_2 is present to the extent of 0.5–10 volume percent in admixture with inert gas.

High-Speed Bearing and Turbine (2,602,632) J. T. Serduke, R. O. Webster—rotor of high-speed turbine is supported and driven by air. Rotor and internal surface of stator have outwardly flaring end surfaces.

Method of Producing Zirconium Tetrafluoride (2,602,725) H. A. Wilhelm, K. A. Walsh—$ZrCl_4$ is reacted with HF at 50° C until 90% conversion to ZrF_4 is effected; reaction is continued at 300° C until substantially complete, obtaining practically nonhydrolyzable ZrF_4.

Nickel Welding (2,602,871) R. A.

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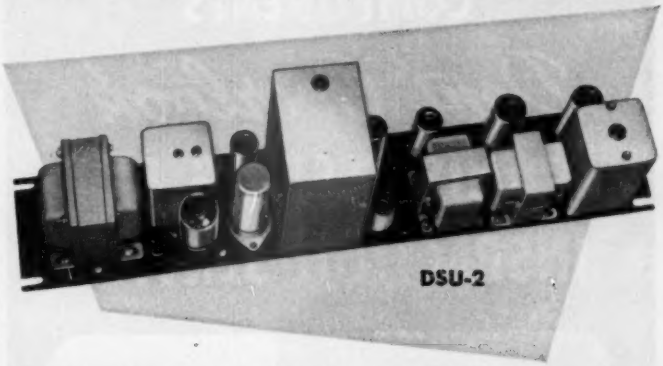

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Ion Intensity Control Mechanism for Mass Spectrometers (2,602,898) M. G. Ingram, Brice M. Rustad—control system feeds vapors to ion source at a rate regulated by flow of ion current to the spectrometer collector.

Radiation Device and Method of Construction (2,602,904) J. A. Simpson, Jr.—G-M radiation counter measures total activity including soft radiations. It is responsive to radiations emanating through a complete solid angle.

Ionization-Gage Regulation (2,604,514) H. G. Neil—improved circuit maintains constant rate of ionization of a gas in a vacuum gage under varying conditions of pressure.

Ionization Chamber for Neutron-Flux Measurements (2,604,598) L. W. Mead, F. C. Armistead—materials used have a minimum neutron-induced radioactivity. Electrodes have neutron-sensitive coatings.

Control Circuit (2,604,612) O. B. Rudolph—improved circuit is particularly useful for controlling speed of a-c motors. Two electric discharge tubes, "back to back," are controlled by a signal to one of the tubes.

Preparation of Radioactive Bromine (2,605,219) H. Jacobson—the vapors of a heated mixture of a volatile metal bromide and an irradiated nonvolatile bromide salt, brought into contact with bromine gas, enter into an exchange process with the gas. The separated gas contains radioactive bromine.

Electronic Analyzer (2,605,332) J. H. Parsons—events, converted into linear positions of a cathode-ray beam, are recorded on photographic film.

Portable Radiation-Survey Instrument (2,605,429) H. V. Herndon, R. G. Hoff—positive feedback, developed in the amplifier input circuit, reduces the response time.

Pulse Generator (2,605,449) G. F. Schrader—two gaseous discharge tubes discharge a section of artificial transmission line and provide a pulse of variable duration in response to an input pulse.

Insulator-Testing Apparatus (2,605,633) J. D. Gow—apparatus, for testing solder joint between porcelain bushing and disk-shaped metal end plate of an insulator, employs an audio oscillator and saw-tooth oscillator. A trace of

the resonant curve of the insulator under test is obtained.

Method and Apparatus for Material Separation (2,606,291) R. R. Wilson—linear-type apparatus separates large quantities of mixed isotopes in relatively short time.

Radiation Counter (2,606,296) J. A. Simpson, Jr.—design improvements provide accurate operation of G-M and proportional counters in the range 125–300 volts.

Adjustable Venturi Assembly (2,606,573) W. M. Brobeck, J. G. Dorward, Jr.—flow-control-indicator assembly, under widely variable fluid-flow conditions, uses an adjustable Venturi tube in combination with a universal-flow indicator.

Dry-Cell Assembly (2,607,809) E. C. Pitzer—improved filler for voltaic cells, which increases voltage stability and recoverability, consists, in part, of acid form of a base exchange resin and saturated NH_4Cl solution.

Electrodeposition of Metal Salts (2,608,530) M. Kahn—process for quantitatively electrodepositing uranium fluoride from dilute aqueous solution of uranyl nitrate containing dissolved NaF.

Fluorination Process (2,608,593) R. D. Fowler, H. C. Anderson—perfluorination of hydrocarbon without scission of the carbon structure is accomplished by passing vaporized hydrocarbon over solid CeF_4 at 100–450° C (above boiling point of starting hydrocarbon).

Means for Measuring Radiation (2,608,661) W. H. Zinn—a phosphor, when subjected to neutron irradiation, activates one of two blocking layer-type photocells connected in series opposition relationship.

Method and Apparatus for Measuring Tightness of Vessels (2,608,855) R. B. Jacobs—rate of inleakage of a closed vessel is measured by surrounding the vessel with helium of constant concentration and measuring the concentration of helium drawn into the vessel by suction.

Injector Mechanism (2,609,500) M. D. Martin—by employing an electrostatic field which guides accelerated particles past the injector, this injector mechanism does not interfere with particle acceleration.

Flow Control (2,610,300) W. W. Walton, R. C. Bowers—a valve, regulated by signals responsive to changes in vapor content in the spectrometer chamber, controls vapor flow to the mass spectrometer.

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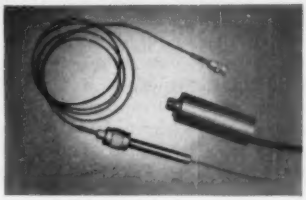

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LETTERS

Neutron Capture Calculations

DEAR SIR:

In an article entitled "Calculation of Yields in Multiple Neutron Capture Processes," (NUCLEONICS, October, 1951, p. 17), R. F. Van Wye and J. G. Beckerley present a generalized method for calculating consecutive nuclear transformations including neutron absorption as well as radioactive decay. Their general expression, Eq. 2, is an extension of that derived in several textbooks* for consecutive radioactive decay processes. To one who has had occasion to apply this equation to transformation sequences of more than three or four members, this expression has two obvious drawbacks. In the first place, the evaluation of the coefficients, $A_{ij}^{m_n}$, becomes tedious for long chains as is evident from Table 1 of their article. Furthermore, the individual terms in the summation are frequently orders of magnitude larger than N_{ij} so that dependable accuracy can be obtained only by using extended tables of exponentials and carrying calculations to more significant figures than seems warranted by the accuracy to which cross sections and decay constants are known.

The writer has developed an alternate general expression in power series form which overcomes these defects of the exponential form and, in fact, permits calculation to sufficient accuracy with a sliderule and without recourse to tables of exponentials.

Derivation of General Expression

Consider the chain of consecutive reactions:

$$N_1 \xrightarrow{k'_1} N_2 \xrightarrow{k'_2} N_3 \xrightarrow{k'_3} \cdots N_n \xrightarrow{k'_n}$$
$$\qquad\quad \downarrow k''_1 \qquad\quad \downarrow k''_2 \qquad\quad \downarrow k''_3 \qquad\quad \downarrow k''_n$$

in which N_i identifies the nuclear species; k_i' denotes the specific reaction rate or probability per unit time for N_i reacting in the direction of the chain and k_i'' the similar probability that N_i will be removed from the chain by all side reactions. Note that k_i' may represent λ_i in the case of radioactive decay, $\varphi\sigma_c(i)$ in the case of neutron capture, or $y_{i+1}\varphi\sigma_f(i)$ if a fission product is in the chain.

Further, define $k_i = k_i' + k_i''$ as the total probability for destruction of N_i. Thus k_i is identical with k_{ii} as defined by Van Wye and Beckerley, and k_i' and k_i'' may be represented by their b's, c's, and f's.

The production rates are given by

$$-\frac{dN_1}{dt} = k_1 N_1$$
$$\frac{dN_i}{dt} = k'_{i-1}N_{i-1} - k_i N_i \qquad (1)$$

By Maclaurin's series

$$N_n(t) = N_n(0) + \left(\frac{dN_n}{dt}\right)_0 t + \left(\frac{d^2N_n}{dt^2}\right)_0 \frac{t^2}{2!} \cdots$$

The coefficients may be evaluated by successive differentiation of Eq. 1. For the case where

$$N_1(0) = N_1^0;\ N_2(0) = N_3(0) = \cdots N_n(0) = 0$$

the first $n-1$ terms in the expansion vanish and one finds the expression

$$\frac{N_n}{N_1^0} = k'_1k'_2 \cdots k'_{n-1}\left[\frac{t^{n-1}}{(n-1)!} - \frac{t^n}{n!}\sum^{n} + \frac{t^{n+1}}{(n+1)!}\sum^{n^2} - \frac{t^{n+2}}{(n+2)!}\sum^{n^3} + \cdots\right] \qquad (2)$$

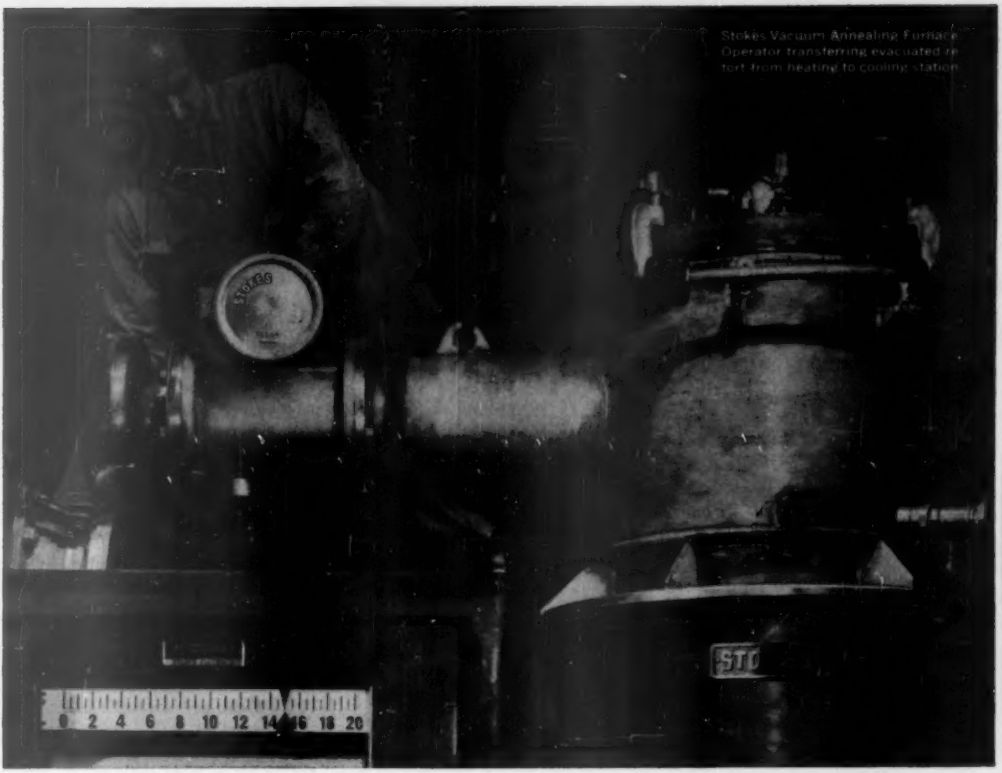
where

$$\sum^{n} \equiv \sum_{i=1}^{n} k_i$$
$$\sum^{n^2} \equiv \sum_{i,j=1}^{n} k_ik_j$$
$$\sum^{n^3} \equiv \sum_{i,j,k=1}^{n} k_ik_jk_k, \text{ etc.} \qquad (3)$$

When only a few points are to be calculated, the writer prefers to rewrite Eq. 2 as

$$\frac{N_n}{N_1^0} = (k'_1t)(k'_2t) \cdots (k'_{n-1}t) \times \left[\frac{1}{(n-1)!} - \frac{1}{n!}\sum^{n} + \frac{1}{(n+1)!}\sum^{n^2} - \cdots\right] \qquad (2a)$$

* For example, E. Rutherford, J. Chadwick, C. D. Ellis, "Radiations from Radioactive Substances," (Cambridge University Press, Cambridge, Eng., 1930); also W. Rubinson, *J. Chem. Phys.* **17**, 542 (1949)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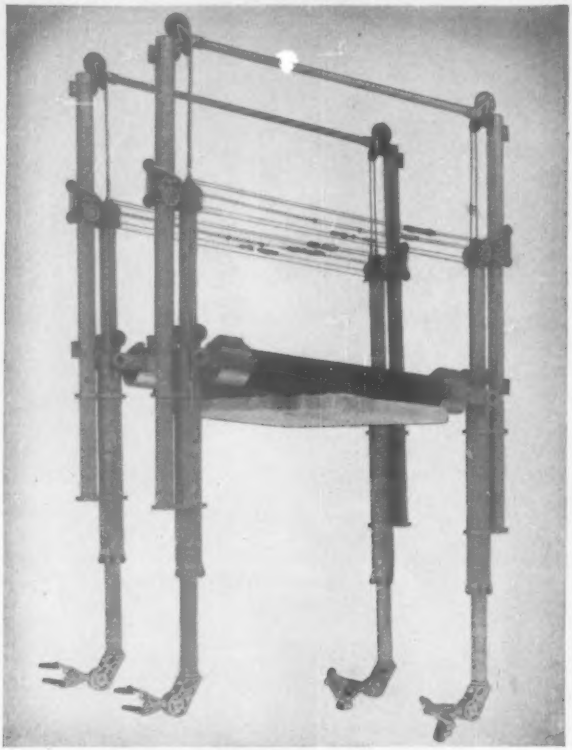

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where the summations are redefined as

$$\sum^{n} = \sum_{i=1}^{n} (k_i l)$$

$$\sum^{n^2} = \sum_{i,j=1}^{n} (k_i l)(k_j l), \text{ etc.} \quad (3a)$$

It should be noted that this expression gives the quantity of the species N_n produced from a single ancestor and by a single path. If more than one ancestor is present at $t = 0$ or if the species is formed by more than one chain of consecutive reactions, it is necessary to evaluate the partial contribution from each ancestor by every possible chain and to add these to get the total amount of the desired species. A similar summation process is included in the A_{ij}^{mn} coefficients of Van Wye and Beckerley.

Calculations based on Eqs. 2 or 2a are greatly facilitated by adopting a standard calculating procedure. As an aid in evaluating the summations within the brackets, it is convenient to arrange the k's in order of decreasing magnitude. Thus, in finding N_3, if $k_1 > k_2 > k_3$, the summations defined by Eq. 3 may be written:

$$\sum^{3} = k_1 + k_2 + k_3$$

$$\sum^{3^2} = k_1 \sum^{3} + k_2(k_2 + k_3) + k_3^2 = k_1 \sum^{3} + A$$

$$\sum^{3^3} = k_1 \sum^{3^2} + k_2 A + k_3^3 = k_1 \sum^{3^2} + B$$

$$\sum^{3^4} = k_1 \sum^{3^3} + k_2 B + k_3^4, \text{ etc.}$$

Summations

$$\sum^{3} = 1.2 + 0.6 + 0.02 \; (= 1.82) \ldots\ldots$$

$$\sum^{3^2} = 1.2(1.82) + 0.6(0.62) + (0.02)^2 \quad (2.182 + 0.372 = 2.554) \ldots\ldots$$

$$\sum^{3^3} = 1.2(2.554) + 0.6(0.372) \quad (3.060 + 0.0223 = 3.082) \ldots\ldots$$

$$\sum^{3^4} = 1.2(3.082) + 0.6(0.0223) \quad (3.70 + 0.013 = 3.71) \ldots\ldots$$

$$\sum^{3^5} = 1.2(3.71) + 0.6(0.013) \quad (= 4.45) \ldots\ldots$$

With the usual spread in values of the k's the latter terms rapidly become insignificant.

Sample Calculation

Problem: To find N_3/N_1^0 with the following arbitrarily selected constants

$$k'_1t = 0.01 \qquad k_1t = 1.2$$
$$k'_2t = 3 \times 10^{-3} \qquad k_2t = 0.02$$
$$k_3t = 0.6$$

Using Eq. 2*a*, we find that the value of the bracketed term becomes that shown in the tabulation below, and $N_3/N_1^0 = (0.01)(3 \times 10^{-3})\ [0.282] = 6.54 \times 10^{-6}$

It is evident that the bracketed term will not converge readily if any of the (k_it)'s are much larger than unity. However, this means only that the nuclear species N_i is approaching equilibrium with its parent (N_{i-1}). In such a case it is generally permissible to simplify Eq. 2*a* by dividing by the large (k_it) and reducing the order (n) of the bracketed expression.

As an actual example to illustrate this case, consider the following problem based on the reaction scheme studied by Van Wye and Beckerley:

Problem: Calculate the concentration of Pa^{234} in thorium irradiated in a neutron flux of 10^{13} for 10^6 seconds.

Inspection of Fig. 1 of the reference article shows that Pa^{234} is produced from Th^{232} by two paths:

A) $Th^{232} \xrightarrow{(n,\gamma)} Th^{233} \xrightarrow{(n,\gamma)} Th^{234} \xrightarrow{\beta} Pa^{234}$

B) $Th^{232} \xrightarrow{(n,\gamma)} Th^{233} \xrightarrow{\beta} Pa^{233} \xrightarrow{(n,\gamma)} Pa^{234}$

For the conditions of the problem,

Factorial term	Plus	Minus
$\frac{1}{2}$	+0.500	
$\frac{1}{6}$		−0.3033
$\frac{1}{24}$	+0.1063	
$\frac{1}{120}$		−0.0257
$\frac{1}{720}$	+0.0051	
$\frac{1}{5040}$		−0.0009
	$\overline{+0.6114}$	$\overline{-0.3299}$
	$[\ ] = 0.2815$	

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F5P-G	F5S-G	—	—	5	.081	.5	.6	4500	1100
F2P-8S-G	F2S-8P-G	2	.043	8	.081	.8	.7	4500	1100
F9P-9S-G	F9S-9P-G	9	.043	9	.081	1.0	9	4500	1100

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the values of $k_i t$ become

	A	B
$k'_1 t =$	6.5×10^{-5}	6.5×10^{-5}
$k'_2 t$	1.5×10^{-2}	492
$k'_3 t$	0.327	3.7×10^{-4}
$k_1 t$	6.5×10^{-5}	6.5×10^{-5}
$k_2 t$	492	492
$k_3 t$	0.327	0.292
$k_4 t$	1.01×10^{4}	1.01×10^{4}

Since in each case both $(k_2 t)$ and $(k_4 t)$ indicate equilibrium conditions, Eq. 2*a* should be modified by using only $(k_1 t)$ and $(k_3 t)$ in the bracketed term with $n = 2$ and replacing the factors outside the brackets with

$$\frac{(k'_1 t)(k'_2 t)(k'_3 t)}{(k_2 t)(k_4 t)}$$

For the series of reactions shown in A, the value of the bracketed term becomes:

$$[\ ] = \begin{array}{rr} +1.000 & -0.292 \\ +0.0426 & -0.0042 \\ \hline 1.043 & -0.296 \end{array} = 0.757$$

and

$$\left(\frac{N_{Pa^{234}}}{N^0_{Th^{232}}}\right)_A = \frac{(6.5 \times 10^{-5})(1.5 \times 10^{-2})(0.327)}{(492)(1.01 \times 10^{4})} \times [0.757] = 4.85 \times 10^{-14}$$

For the series of reactions shown in B, the value of the bracketed term becomes:

$$[\ ] = \begin{array}{rr} +1.000 & -0.327 \\ +0.0535 & -0.0058 \\ \hline 1.054 & -0.333 \end{array} = 0.721$$

and

$$\left(\frac{N_{Pa^{234}}}{N^0_{Th^{232}}}\right)_B = \frac{(6.5 \times 10^{-5})(492)(3.7 \times 10^{-4})}{(492)(1.01 \times 10^{4})} \times [0.721] = 1.73 \times 10^{-12}$$

The total amount of Pa^{234} produced is the sum of the amounts formed by the separate paths, or 1.78×10^{-12} grams per gram of thorium initially present.

The modified procedure produces a significant error only when applied for $(k_i t) \gtrsim 5.0$. For example, the fractional approach to equilibrium $(1 - e^{-k_i t})$ represented by $(k_i t)$ values in this range are

$k_i t$	$(1 - e^{-k_i t})$
5.0	0.993
4.0	0.982
3.0	0.950
2.0	0.865

Since values for the neutron cross sections, decay constants, and neutron

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fluxes, are seldom known to better than a few per cent at best, the modified procedure is generally satisfactory for providing a series that converges in relatively few terms. In doubtful cases, a correction factor of $(1 - e^{-k_{ad}t})$ applied to the first approximation will give a result even closer to the correct one.

Incidentally, there is an obvious inconsistency in the plot of Fig. 4 of the reference article. The total destruction of Th^{232} when 1 gram of thorium is the starting material is given by $1 - e^{-k_{act}t}$. At a thermal neutron flux of 10^{13} n/cm²/sec and time of 10^8 seconds, this is for all practical purposes equal to $k_{act}t = 6.5 \times 10^{-6}$ grams. The sum of all product isotopes can be no greater than this, but the plot shows Pa^{233} alone at roughly 2×10^{-7} grams. There could be a decimal point error in plotting this point, but I suspect a calculation error due to the use of the exponential form of equation for very small values of t. It is in just this range that the power series form of equation is most appropriate. Using the equations and method of this letter the calculated quantities at 10^8 seconds are 1.4×10^{-6} grams of Pa^{233}; 5×10^{-8} grams of Th^{232}, and 4.2×10^{-12} grams of Th^{234} when 1 gram of thorium is the starting material. The equilibrium amounts are plotted correctly.

It is not clear whether the basis for Fig. 4 is 1 gram of thorium at time t or at time $t = 0$. There is essentially no difference up to $t = 10^8$ seconds. Thereafter, the curves for all isotopes would "decay" with the same mean life as Th^{232} if referred to 1 gram of thorium at time $t = 0$ but would remain horizontal as shown referred to 1 gram of thorium at time t.

HENRY C. OTT
U. S. Atomic Energy Commission
Washington 25, D. C.

Need for a Radiation Society

DEAR SIR:

I would like to urge the formation or consideration of a radiation protection association, society, group (call it what you will) for closer communication and solution of mutual problems. I first noted the need for such a group while engaged in health-physics work at Brookhaven National Laboratory (even though liaison between practicing health-physics groups within the AEC program was active). In my present work as a radiophysicist (health physicist) with the New York

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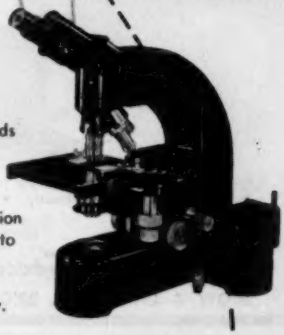

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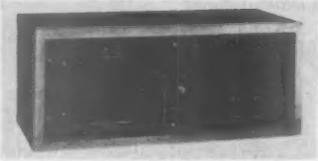

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There are many individual organizations engaged in radiation protection and detection of some sort. These include the various armed services, civilian defense, state and local public and industrial health groups, federal health groups, AEC contractors, the AEC itself, radiation consultants, schools, hospitals, the Interstate Commerce Commission, the U. S. Post Office, and many of those industrial firms using naturally occurring radioactive materials. The greatest concentration of finances and manpower is, of course, in the AEC and its contractors. However, the magnitude of the problems of radiation protection is no less among the other interested parties.

The main purpose of such a radiation society would be to concentrate the technical achievements and the philosophies of radiation protection of these separate groups and provide a forum for discussion on the specific problems associated with protecting personnel from ionizing radiations. I feel very strongly about this problem and have contacted you in the recognition that your publication has appeared to offer the closest thing to a journal suitable for such a society. It is my understanding that members of the American Industrial Hygiene Association have been similarly concerned with this problem. I have noted that industry in New York has expressed interest in the clarification of hazards to be associated with the use of radioactive materials and radiation in industrial processes. However, no central office is available for consultation other than the AEC itself.

In the course of this discussion, let us remember that the AEC has been entering the field of industrial safety on a new scale. Heretofore, the various state and local groups held themselves primarily responsible for problems of industrial hazards and public health hazards. This responsibility for the control of health hazards by the AEC extends only to reactor-produced materials and some accelerator products. The volume of X-ray equipment and naturally occurring radioactive material outside the responsibility of the AEC is probably presenting hazards to more persons than are currently being carefully supervised by the AEC. It is the equating of these types of exposure to radiation, AEC and non-AEC,

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that is strongly needed. Local health groups will need to draw on the experience of the AEC groups with regard to experimental data on tolerances, instrumentation, and training, and these groups are now actively trying to do so. The training of qualified "experts" in the field of health physics remains a considerable step in solving non-AEC problems.

Perhaps other readers of NUCLEONICS might be interested in commenting on the idea of a central group of persons primarily interested in the protection of personnel from radiation.

SAUL J. HARRIS
Associate Radiophysicist, Division of Industrial Hygiene and Safety Standards Department of Labor, State of New York
New York, New York

(*NUCLEONICS has felt the need for some time for a single society rather than numerous professional groups which cover only portions of the nucleonics field. We welcome suggestions from our readers on this whole question.*—Editor)

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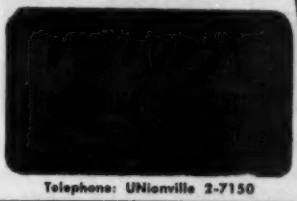

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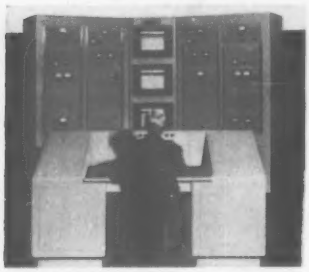

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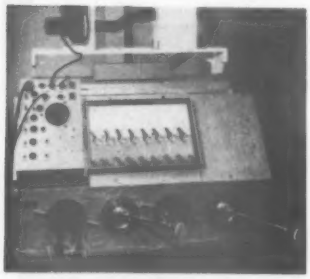

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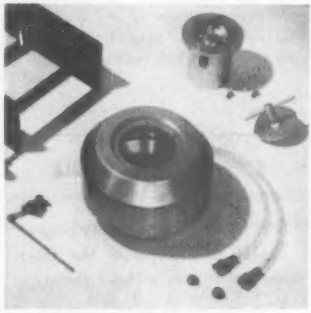

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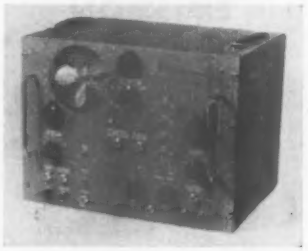

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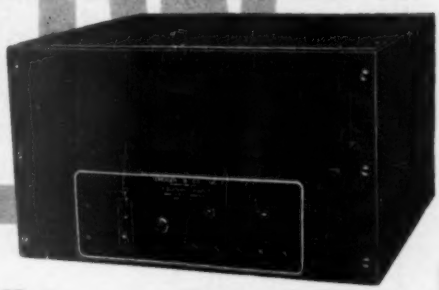

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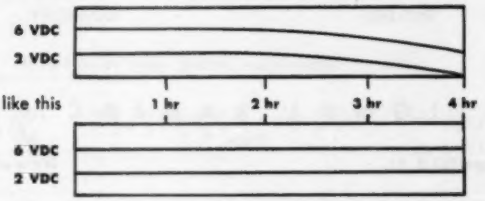

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Input voltage range	95-130VAC, 1Φ, 50-60 cycles
Output	
#1 for lamp	6VDC adjustable ±10% at 5 amperes
#2 for filament	6VDC at 100 Ma.
#3 for bias	2VDC adjustable ±10% at 100 Ma.
Filtering	
#1	1% max.
#2 & 3	0.05% max.
Regulation accuracy	±0.01% against line changes
Time constant	0.1 seconds under most severe line changes
Size:	17 x 12¼ x 17 self contained 19 x 12¼ panel for relay rack mounting
Weight:	Approximately 90 pounds
Meters:	No meters are provided due to the extreme regulation accuracy involved.

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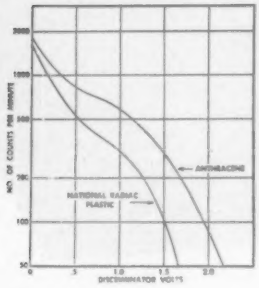

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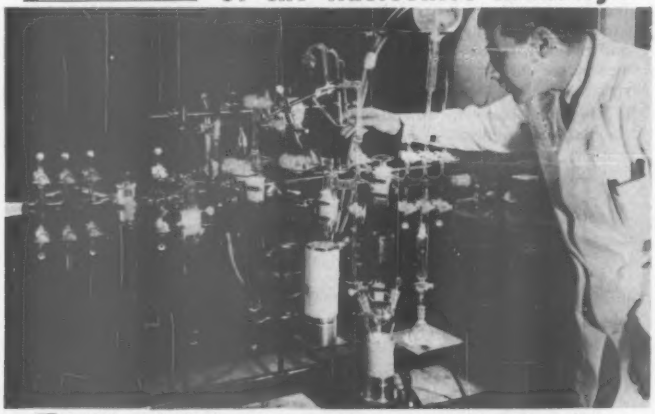

TYPICAL of KONTES' ability to produce for the Nucleonic's Industry exacting glass apparatus is evidenced by the above picture.

Shown here is a researcher preparing apparatus for the synthesis of a compound containing radioactive carbon in the Radioisotope Laboratory of E. R. Squibb & Sons, New Brunswick, N. J., where a study of the metabolic processes of antibiotic-producing organisms, using radioisotopes as tracers, is being conducted. *Write For Information On Your Requirements*

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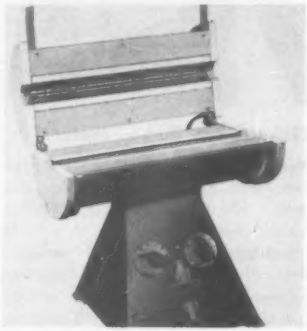
the CK5889 subminiature pentode electrometer has a conducting guard ring around the body of the tube. Maximum control-grid current is 3×10^{-15} amp for pentode operation; the tube can also be operated as a triode. The filament uses 7.5 ma at 1.25 volts. For pentode operation, transconductance is 10 μmhos, plate current is 4 μa at 12 volts, and screen-grid current is 4 μa at 4 volts. The amplification factor is 250. Control-grid voltage is −2 volts.



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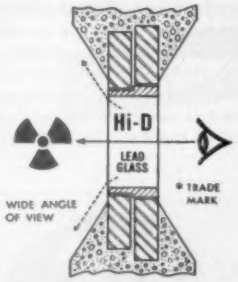

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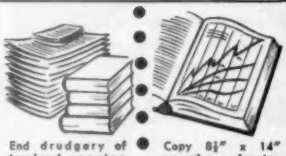

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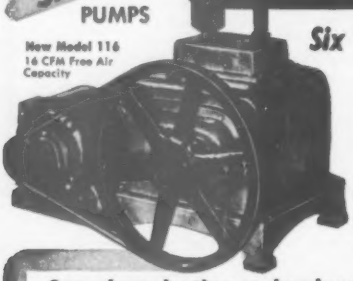

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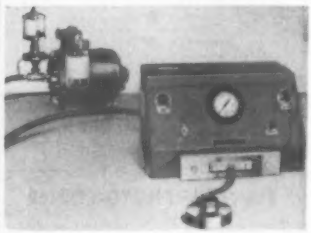

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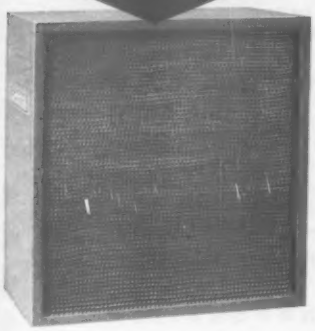

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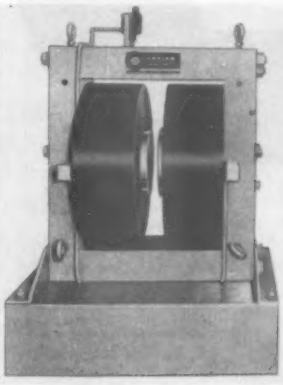

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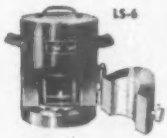

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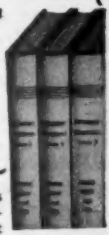

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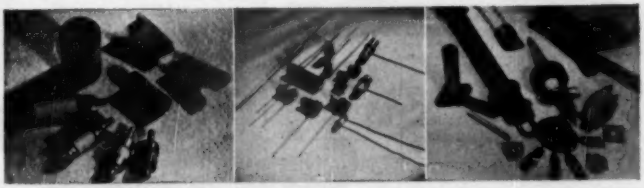

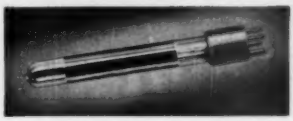

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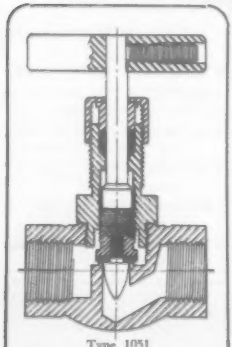

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INDUSTRY NOTES

▶**Computer Corp. of America,** 149 Church St., New York 7, N. Y., has inaugurated a service furnishing solutions to complex problems in dynamics. Problems will be accepted for analysis and solution whether or not a computer is required.

▶**Walter Kidde Nuclear Laboratories,** 140 Cedar St., New York, N. Y., has announced the appointment of Charles W. Hammond as head of its mechanical engineering department.

▶**Isotopes Specialties Co.,** 3816 San Fernando Rd., Glendale, Calif., has placed R. E. Selff, formerly of the carbon-14 group at the University of California radiation laboratory, in charge of organic syntheses.

▶**Foster D. Snell, Inc.,** 29 W. 15th St., New York 11, N. Y., has announced the availability of its radiology department facilities for industrial application of radioisotope techniques. The department has done work in such fields as radiological decontamination, and application of radioisotopes to agriculture, surface chemistry, and analytical procedures.

▶**Radiation Counter Laboratories, Inc.,** 5122 W. Grove St., Skokie, Ill., has appointed C. Gilbert Goss as director of electronic research. Mr. Goss was development engineer in electronic circuitry at ORNL for the past four and one-half years.

▶**Nuclear Instrument and Chemical Corp.,** 223 W. Erie St., Chicago 10, Ill., had sales totaling $838,607.40 for the nine months ending May 31, 1952, compared to $590,555.36 for the same period last year. Current backlog of

orders is in excess of $1,500,000 in government and industry contracts.

▶**Plastic Capacitors, Inc.,** 2511 W. Moffat St., Chicago 47, Ill., is newly organized as a manufacturer of high-voltage low-current power supplies, pulse-forming networks, and plastic-film capacitors.

▶**Isotope Products, Ltd.,** Oakville, Ontario, has moved into a new 4,000-square-foot plant. The plant includes a "hot" lab, radiography facilities, space for development, engineering, assembly and testing, and offices. This is the first of several buildings the company plans to erect.

LITERATURE AVAILABLE

Solenoid control unit. Brochure describes oil-damped solenoids. *Scully Machine Co., 62 Walter St., Bridgeport 8, Conn.*

Relief valve. Bulletin 290 lists data on safety relief valve. *A. W. Cash Valve Mfg. Corp., 666 E. Wabash Ave., Decatur, Ill.*

Contacts. Catalog C-520 describes properties and uses of line of electrical contacts. *Gibson Electric Co., 8400 Frankstown Ave., Pittsburgh 21, Pa.*

Plastic pipe. Catalog gives data on plastic pipe, tubing, and fittings. *American Agile Corp., Box 168, Bedford, Ohio.*

Iron cores. Bulletin IC-P8 lists details of powder-iron cores. *Lenkurt Electric Co., 1114 County Rd., San Carlos, Calif.*

Attenuators. Pamphlet gives technical data on line of r-f attenuators. *The Daven Co., Dept. RF, 191 Central Ave., Newark 4, N. J*

Magnets. Catalog 12 lists specifications for sintered permanent magnets. *The Indiana Steel Products Co., Valparaiso, Ind.*

Development apparatus. Brochure MDA-200 describes components for breadboard and semipermanent assembly of control systems and analog computers. *Servomechanisms Inc., Post and Stewart Aves., Westbury, N. Y.*

Electronic instruments. Catalog 21-A describes line of electronic measuring instruments and accessory equipment. *Hewlett-Packard Co., 395 Page Mill Rd., Palo Alto, Calif.*

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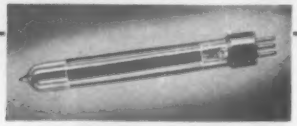

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Ferranti Electric, Inc., 30 Rockefeller Plaza, New York 20, N. Y.
GENERAL ELECTRIC CO., Apparatus Sales Div., Schenectady 5, N. Y. ADV. PGS. 2–5
Hickok Electrical Instrument Co., The, 10514 Dupont Ave., Cleveland 8, Ohio
Martindale Electric Co., 1375 Hird Ave., Cleveland 7, Ohio
Pyramid Instrument Corp., 630 Merrick Road, Lynbrook, N. Y.
Stickt, Inc., Herman H., 27 Park Place, New York 7, N. Y.
WESTON ELECTRICAL INSTRUMENT CORP., 614 Frelinghuysen Ave., Newark 5, N. J. ADV. PG. 102

AMMETERS—DC Portable

Allied Radio Corp., 833 W. Jackson Blvd., Chicago 7, Ill.
Assembly Products, Inc., Chagrin Falls 6, Ohio
Baldwin Instrument Co., Ltd., Brooklands Works, Dartford, Kent, England
Cole Instrument Co., 1320 S. Grand Ave., Los Angeles 15, Calif.
Electronic Instrument Co., Inc., 276 Newport St., Brooklyn 12, N. Y.
GENERAL ELECTRIC CO., Apparatus Sales Div., Schenectady 5, N. Y. ADV. PGS. 2–5
Hickok Electrical Instrument Co., The, 10514 Dupont Ave., Cleveland 8, Ohio
Instrument Laboratories, 315 W. Walton Place, Chicago 10, Ill.
International Instruments, Inc., P. O. Box 2954, New Haven 15, Conn.
Martindale Electric Co., 1375 Hird Ave., Cleveland 7, Ohio
Measurement Engineering Ltd., Arnprior, Ontario, Canada
Oak Ridge Products Mfg. Div., Video Television, Inc., 37-01 Vernon Blvd., Long Island City 1, N. Y.
Rhoastron Co., 151 Pasadena Ave., South Pasadena, Calif.
Radio City Products Co., Inc., 152 W. 25th St., New York 1, N. Y.
Rawson Electrical Instrument Co., 114 Potter St., Cambridge 42, Mass.
Roller-Smith Corp., 1000 Eighth Ave., Bethlehem, Pa.
Square Root Mfg. Corp., 391 Saw Mill River Rd., Yonkers, N. Y.
Stickt, Inc., Herman H., 27 Park Place, New York 7, N. Y.
Sun Electric Corp., 6323 Avondale Ave., Chicago 31, Ill.
Triplett Electrical Instrument Co., 286 Harmon Rd., Bluffton, Ohio
Welch Scientific Co., W. M., 1515 Sedgwick St., Chicago 10, Ill.
Westinghouse Electric Corp., P. O. Box 868, Pittsburgh 30, Pa.
WESTON ELECTRICAL INSTRUMENT CORP., 614 Frelinghuysen Ave., Newark 5, N. J. ADV. PG. 102

AMPLIFIERS—Audio Frequency

Air Associates, Inc., Teterboro, N. J.
Allied Radio Corp., 833 W. Jackson Blvd., Chicago 7, Ill.
American Communications Corp., 306 Broadway, New York 7, N. Y.
American Electroscience Co., 2112 S. LaBrea Ave., Los Angeles, Calif.
American Electronic Laboratories, Inc., 641 Arch St., Philadelphia 6, Pa.
Audio Instrument Co., 133 W. 14th St., New York 11, N. Y.
Avion Instrument Corp., Paramus, N. J.
Ballantine Laboratories, Inc., Boonton, N. J.
Bogue Electric Mfg. Co., 52 Iowa Ave., Paterson 3, N. J.
Centralab Division of Globe-Union, Inc., 900 E. Keefe Ave., Milwaukee 1, Wis.
Cinema Engineering Co., 1510 W. Verdugo Ave., Burbank, Calif.
Collins Radio Co., Cedar Rapids, Iowa
Cossor (Canada) Ltd., 301 Windsor St., Halifax, N. S., Canada
Douglas Radio Labs., 176 Norfolk Ave., Boston 19, Mass.
Electric & Musical Industries Ltd., Hayes, Middlesex, England
Elm Laboratories, 18 South Broadway, Dobbs Ferry, N. Y.
El-Tronics, Inc., 2649 N. Howard St., Philadelphia 33, Pa.
Engineering Research Associates, Inc., 1902 W. Minnehaha Ave., St. Paul 4, Minn.
Fairchild Recording Equipment Corp., 154th St. & 7th Ave., Whitestone, N. Y.
Fluke Engineering Co., John, 1111 W. Nickerson St., Seattle 99, Wash.
Ford Instrument Co., 31-10 Thomson Ave., Long Island City, N. Y.
Freed Transformer Co., Inc., 1736 Weirfield St., Brooklyn 27, N. Y.
FURST ELECTRONICS, 3322A W. Lawrence Ave., Chicago 25, Ill. ADV. PG. 110
Gaveco Labs., Inc., 2 East End Ave., New York 21, N. Y.
General Radio Co., 275 Massachusetts Ave., Cambridge 39, Mass.
Gulton Mfg. Corp., 212 Durham Ave., Metuchen, N. J.
Hartley Co., Ltd., H. A., 152 Hammersmith Rd., London W. 6, England
Heath Co., Benton Harbor, Mich.
Hewlett-Packard Co., 395 Page Mill Rd., Palo Alto, Calif.
Highland Engineering Co., Main St. & Urban Ave., Westbury, N. Y.
Industrial Science Associates, 542 Fifth Ave., New York 19, N. Y.
Interelectronics Corp., 2432 Grand Concourse, New York 58, N. Y.
Jewil Electronics Inc., 7945 Germantown Ave., Philadelphia 18, Pa.
Keithley Instruments, 3868 Carnegie Ave., Cleveland, Ohio
Krohn-Hite Instrument Co., 580 Massachusetts Ave., Cambridge 39, Mass.
Langevin Mfg. Corp., 37 W. 65th St., New York 23, N. Y.
Leland Instruments Ltd., 22-23 Millbank, London, S. W. 1, England
McIntosh Engineering Lab., Inc., 320 Water St., Binghamton, N. Y.
Maurer, Inc., J. A., 37-01 31st St., Long Island City, N. Y.
MEASUREMENTS CORP., Boonton, N. J. ADV. PG. 96
Melpar Inc., 452 Swann Ave., Alexandria, Va.
Mercury Electronic Co., Box 450, Red Bank, N. J.
MICHEL MFG. CO., 227 N. Water St., Milwaukee 2, Wis. ADV. PG. 134
Mullard Overseas Ltd., Century House, Shaftesbury Ave., London W. C. 2, England
National Intercommunicating Systems, Inc., 1130 N. Milwaukee Ave., Chicago 22, Ill.
Network Mfg. Corp., 213 W. 5th St., Bayonne, N. J.
Newcomb Audio Products Co., 6824 Lexington Ave., Hollywood 38, Calif.
Nuclear Specialty Co., P. O. Box 455, Center Moriches, N. Y.
Pacific Division, Bendix Aviation Corp., 11600 Sherman Way, North Hollywood, Calif.
Patterson, Moos & Co., Inc., 32-36 47th Ave., Long Island City 1, N. Y.
Phoenix Precision Instrument Co., 3803-05 N. 5th St., Philadelphia, Pa.
Plastics & Electronics Co., 272 Northland Ave., Buffalo 8, N. Y.
Precision Electronics, 641 Milwaukee Ave., Chicago 22, Ill.
Rauland-Borg Corp., 3523 W. Addison St., Chicago 18, Ill.
Ripley Co., Inc., 22 W. First St., Mt. Vernon, N. Y.
Rosen Engineering Products, Inc., Raymond, 32nd & Walnut St., Philadelphia 4, Pa.
Scott Inc., Herman Hosmer, 385 Putnam Ave., Cambridge, Mass.
Simpson Mfg. Co., Inc., Mark, 32-28 49th St., Long Island City 3, N. Y.
Southwestern Industrial Electronic Co., 3831 Post Oak Rd., P. O. Box 13058, Houston 19, Texas
Square Root Mfg. Corp., 391 Saw Mill River Rd., Yonkers, N. Y.
Standard Electronics Research Corp., 2 East End Ave., New York 21, N. Y.
Stephens Mfg. Corp., 8538 Warner Drive, Culver City, Calif.
T. L. G. Electric Corp., 31 W. 27th St., New York 1, N. Y.
Tech Laboratories, Inc., Bergen & Edsall Blvds., Palisades Park, N. J.
Telectro Industries Corp., 35-18 37th St., Long Island City 1, N. Y.
Thordarson-Meissner Mfg. Divs., Mt. Carmel, Ill.
Transformers Specialty Co., Bala-Cynwyd, Pa.
United Transformer Co., 150 Varick St., New York 13, N. Y.
Walkirt Co., 145 W. Hazel, Inglewood, Calif.
Waveforms, Inc., 333 Sixth Ave., New York 14, N. Y.
Western Electro-Acoustic Labs., 204 S. Beverly Drive, Beverly Hills, Calif.
Western Sound & Electric Labs., Inc., 805 S. Fifth St., Milwaukee 4, Wis.

AMPLIFIERS—d-c

Acme Electronics, Inc., 308 N. Lake Ave., Pasadena 4, Calif.
Advance Electronics Co., 451 Highland Ave., Passaic, N. J.
American Communications Corp., 306 Broadway, New York 7, N. Y.
American Electronic Laboratories, Inc., 641 Arch St., Philadelphia 6, Pa.
Atomics, Inc., 489 Fifth Ave., New York 17, N. Y.
Audio Instrument Co., Inc., 133 W. 14th St., New York 11, N. Y.
Avion Instrument Corp., Paramus, N. J.
Baldwin Instrument Co., Ltd., Brooklands Works, Dartford, Kent, England
BETA ELECTRIC CORP., 333 E. 103rd St., New York 29, N. Y. ADV. PG. 120
Bogue Electric Mfg. Co., 52 Iowa Ave., Paterson 3, N. J.
Brush Development Co., 3405 Perkins Ave., Cleveland 14, Ohio
Collins Radio Co., Cedar Rapids, Iowa
Computer Corp. of America, 149 Church St., New York, N. Y.
Cossor (Canada) Ltd., 301 Windsor St., Halifax, N. S., Canada
Douglas Radio Labs., 176 Norfolk Ave., Boston 19, Mass.
DuMont Labs., Inc., Allen B., 1000 Main Ave., Clifton, N. J.
Edin Co., Inc., 207 Main St., Worcester, Mass.
Electrodyne Co., 32 Oliver St., Boston, Mass.
Electro-Mechanical Research, Inc., 64 Main St., Ridgefield, Conn.
ELECTRONIC ASSOCIATES, INC., Long Branch, N. J. ADV. PG. 9
Electronic Control Corp., 1873 E. Forest St., Detroit 7, Mich.

Electronic Tube Corp., 1200 E. Mermaid Lane, Philadelphia 18, Pa.
El-Tronics, Inc., 2649 N. Howard St., Philadelphia 33, Pa.
Freed Transformer Co., Inc., 1736 Weirfield St., Brooklyn 27, N. Y.
FURST ELECTRONICS, 3322A W. Lawrence Ave., Chicago 25, Ill. ADV. PG. 110
GENERAL ELECTRIC CO., Apparatus Sales Div., Schenectady 5, N. Y. ADV. PGS. 2–5
General Magnetics, Inc., 135 Bloomfield Ave., Bloomfield, N. J.
General Radio Co., 275 Massachusetts Ave., Cambridge 39, Mass.
Goodyear Aircraft Corp., Akron 15, Ohio
Gulton Mfg. Corp., 212 Durham Ave., Metuchen, N. J.
Highland Engineering Co., Main St. & Urban Ave., Westbury, N. Y.
Industrial Control Co., Straight Path & Arlington Ave., Wyandanch, N. Y.
Industrial Science Associates, 542 Fifth Ave., New York 19, N. Y.
Interelectronics Corp., 2432 Grand Concourse, New York 58, N. Y.
Jawil Electronics Inc., 7945 Germantown Ave., Philadelphia 18, Pa.
Keithley Instruments, 3868 Carnegie Ave., Cleveland, Ohio
Krohn-Hite Instrument Co., 580 Massachusetts Ave., Cambridge 39, Mass.
Leeds & Northrup Co., 4970 Stenton Ave., Philadelphia 44, Pa.
Leland Instruments Ltd., 22–23 Millbank, London, S. W. 1, England
Liston-Becker Instrument Co., Inc., 20 Beckley Ave., Stamford, Conn.
Magnetic Amplifiers, Inc., 632 Tinton Ave., New York 55, N. Y.
Measurement Engineering Ltd., Arnprior, Ontario, Canada
Meipar Inc., 452 Swann Ave., Alexandria, Va.
Mercury Electronic Co., Box 450, Red Bank, N. J.
Miller Corp., William, 325 N. Halstead Ave., Pasadena 8, Calif.
MINNEAPOLIS-HONEYWELL REGULATOR CO., Wayne & Roberts Aves., Philadelphia 44, Pa. ADV. PG. 29
Network Mfg. Corp., 213 W. 5th St., Bayonne, N. J.
Nuclear Specialty Co., P. O. Box 455, Center Moriches, N. Y.
Ohmart Corp., The, 2347 Ferguson Ave., Cincinnati 38, Ohio
Patterson, Moos & Co., Inc., 32–36 47th Ave., Long Island City 1, N. Y.
Perkin-Elmer Corp., Norwalk, Conn.
Phoenix Precision Instrument Co., 3803–05 N. 5th St., Philadelphia, Pa.
Plastics & Electronics Co., 272 Northland Ave., Buffalo 8, N. Y.
Process & Instruments, 60 Greenpoint Ave., Brooklyn 22, N. Y.
Radiation Counter Labs., Inc., 1844 W. 21st St., Chicago 8, Ill.
Ripley Co., Inc., 22 W. First St., Mt. Vernon, N. Y.
SANBORN CO., 39 Osborn St., Cambridge, Mass. ADV. PG. 92
Southwestern Industrial Electronic Co., 2831 Post Oak Rd., P. O. Box 13058, Houston 19, Texas
Special Instruments Laboratory, Inc., 1003 Highland Ave., Knoxville, Tenn.
Square Root Mfg. Corp., 391 Saw Mill River Rd., Yonkers, N. Y.
Standard Electronics Research Corp., 2 East End Ave., New York 21, N. Y.
T. L. G. Electric Corp., 31 W. 27th St., New York 1, N. Y.
Tech Laboratories, Inc., Bergen & Edsall Blvds., Palisades Park, N. J.
TECHNICAL OPERATIONS, INC., 6 Schouler Court, Arlington 74, Mass. ADV. PG. 128
Tektronix, Inc. P. O. Box 831, Portland 7, Ore.
Thordarson-Meissner Mfg. Divs., Mt. Carmel, Ill.
Vickers Electric Division, Vickers, Inc., 1815 Locust St., St. Louis, Mo.
VICTOREEN INSTRUMENT CO., 3800 Perkins Ave., Cleveland 14, Ohio. ADV. PG. Inside Front Cover
Watkirt Co., 145 W. Hazel, Inglewood, Calif.
Western Radiation Lab., 1107 W. 24th St., Los Angeles 27, Calif.
Western Sound & Electric Labs., Inc., 805 S. Fifth St., Milwaukee 4, Wis.

AMPLIFIERS—Linear

American Communications Corp., 306 Broadway, New York 7, N. Y.
American Electronic Laboratories, Inc., 641 Arch St., Philadelphia 6, Pa.
ATOMIC INSTRUMENT CO., 84 Massachusetts Ave., Cambridge 39, Mass. ADV. PG. 23
Atomlab, Inc., 489 Fifth Ave., New York 17, N. Y.
Audio Instrument Co., Inc., 133 W. 14th St., New York 11, N. Y.
Avion Instrument Corp., Paramus, N. J.
Bogue Electric Mfg. Co., 52 Iowa Ave., Paterson 3, N. J.
COLE, LTD., E. K., Electronics Div., Malmesbury, Wiltshire, England. ADV. PG. 28
Consolidated Engineering Corp., 300 N. Sierra Madre Villa, Pasadena 8, Calif.
Douglas Radio Labs., 176 Norfolk Ave., Boston 19, Mass.
Electrodyne Co., 32 Oliver St., Boston, Mass.
Electro-Mechanical Research, Inc., 64 Main St., Ridgefield, Conn.
El-Tronics, Inc., 2649 N. Howard St., Philadelphia 33, Pa.
Fleming Radio Ltd., 18–20 Laystall St., London, E. C. 1, England
Ford Instrument Co., 31–10 Thomson Ave., Long Island City, N. Y.
General Magnetics, Inc., 135 Bloomfield Ave., Bloomfield, N. J.
Goodyear Aircraft Corp., Akron 15, Ohio
Gulton Mfg. Corp., 212 Durham Ave., Metuchen, N. J.
Highland Engineering Co., Main St. & Urban Ave., Westbury, N. Y.
Industrial Science Associates, 542 Fifth Ave., New York 19, N. Y.
Krohn-Hite Instrument Co., 580 Massachusetts Ave., Cambridge 39, Mass.
Leland Instruments Ltd., 22–23 Millbank, London, S. W. 1, England
Newcomb Audio Products Co., 6824 Lexington Ave., Hollywood 38, Calif.
NUCLEAR INSTRUMENT & CHEMICAL CORP., 223 W. Erie St., Chicago 10, Ill. ADV. PG. Back Cover
Nuclear Measurements Corp., 2460 N. Arlington Ave., Indianapolis 18, Ind.
NUCLEAR RESEARCH & DEVELOPMENT INC., 1094 Sutter Ave., St. Louis, Mo. ADV. PG. 103
Nuclear Specialty Co., P. O. Box 455, Center Moriches, N. Y.
Patterson, Moos & Co., Inc., 32–36 47th Ave., Long Island City 1, N. Y.
Phoenix Precision Instrument Co., 3803–05 N. 5th St., Philadelphia, Pa.
Radiation Counter Labs., Inc., 1844 W. 21st St., Chicago 8, Ill.
RADIATION INSTRUMENT DEVELOPMENT LAB., 2337 W. 67th St., Chicago 36, Ill. ADV. PG. Inside Back Cover
Scott, Inc., Hermon Hosmer, 385 Putnam Ave., Cambridge 39, Mass.
SPENCER-KENNEDY LABS., INC., 186 Massachusetts Ave., Cambridge 39, Mass. ADV. PG. 12
Square Root Mfg. Corp., 391 Saw Mill River Rd., Yonkers, N. Y.
Standard Electronics Research Corp., 2 East End Ave., New York 21, N. Y.
Stephens Mfg. Corp., 8538 Warner Drive, Culver City, Calif.
T. L. G. Electric Corp., 31 W. 27th St., New York 1, N. Y.
Technology Instrument Corp., 531 Main St., Acton, Mass.
Telectro Industries Corp., 35–18 37th St., Long Island City 1, N. Y.
Thordarson-Meissner Mfg. Divs., Mt. Carmel, Ill.
TRACERLAB, INC., 130 High St., Boston 10, Mass. ADV. PG. 24
Vickers Electric Division, Vickers, Inc., 1815 Locust St., St. Louis, Mo.
Waveforms, Inc., 233 Sixth Ave., New York 14, N. Y.
Western Sound & Electric Labs., Inc., 805 S. Fifth St., Milwaukee 4, Wis.

AMPLIFIERS—Magnetic

Acme Electronics, Inc., 300 N. Lake Ave., Pasadena 4, Calif.
American Communications Corp., 306 Broadway, New York 7, N. Y.
American Electric Motors, Inc., 4811–13 Telegraph Rd., Los Angeles, Calif.
Bogue Electric Mfg. Co., 52 Iowa Ave., Paterson 3, N. J.
Bogue Railway Equipment Div. of Bogue Electric Mfg. Co., 52 Iowa Ave., Paterson 3, N. J.
C G S Laboratories, Inc., 391 Ludlow St., Stamford, Conn.
Cole Instrument Co., 1320 S. Grand Ave., Los Angeles 15, Calif.
Ford Instrument Co., 31–10 Thomson Ave., Long Island City, N. Y.
Freed Transformer Co., Inc., 1736 Weirfield St., Brooklyn 27, N. Y.
GENERAL ELECTRIC CO., Apparatus Sales Div., Schenectady 5, N. Y. ADV. PGS. 2–5
General Magnetics, Inc., 135 Bloomfield Ave., Bloomfield, N. J.
General Precision Laboratory, Inc., Pleasantville, N. Y.
Highland Engineering Co., Main St. & Urban Ave., Westbury, N. Y.
Hycor Co., Inc., 11423 Vanowen St., North Hollywood, Calif.
Industrial Research Products, Inc., 9400 Belmont Ave., Franklin Park, Ill.
Industrial Science Associates, 542 Fifth Ave., New York 19, N. Y.
Inst, Inc., 8655 S. Main St., Los Angeles 3, Calif.
K-V Transformer Corp., 20 E. Franklin St., Danbury, Conn.
Keystone Products Co., 904–6 23rd St., Union City, N. J.
Librascope, Inc., 1607 Flower St., Glendale 1, Calif.
Magnetic Amplifiers, Inc., 632 Tinton Ave., New York 55, N. Y.
Maurer, Inc., J. A., 37–01 31st St., Long Island City, N. Y.
Miller Corp., William, 325 N. Halstead Ave., Pasadena 8, Calif.
Pentron Corp., 221 E. Cullerton St., Chicago 16, Ill.
Phoenix Precision Instrument Co., 3803–05 N. 5th St., Philadelphia, Pa.
Radiation Counter Labs., Inc., 1844 W. 21st St., Chicago 8, Ill.
Raytheon Mfg. Co., Equipment Sales Div., Waltham 54, Mass.
Resdel Engineering, 2351 Riverside Drive, Los Angeles 39, Calif.
Servo Corp. of America, 2020 Jericho Turnpike, New Hyde Park, N. Y.
Specialties, Inc., Skunks Misery Rd., Syosset, N. Y.
Square Root Mfg. Corp., 391 Saw Mill River Rd., Yonkers, N. Y.
Standard Electronics Research Corp., 2 East End Ave., New York 21, N. Y.
T. L. G. Electric Corp., 31 W. 27th St., New York 1, N. Y.
Thordarson-Meissner Mfg. Divs., Mt. Carmel, Ill.
Transformers Specialty Co., Bala-Cynwyd, Pa.
Varo Mfg. Co., Inc., Box 638, Garland, Texas
Vickers Electric Division, Vickers, Inc., 1815 Locust St., St. Louis, Mo.
Watkirt Co., 145 W. Hazel, Inglewood, Calif.
Wang Laboratories, 296 Columbus Ave., Boston 16, Mass.
Westinghouse Electric Corp., P. O. Box 868, Pittsburgh 30, Pa.

AMPLIFIERS—r-f

Acme Electronics, Inc., 300 N. Lake Ave., Pasadena 4, Calif.
Air Associates, Inc., Teterboro, N. J.
American Communications Corp., 306 Broadway, New York 7, N. Y.
Atomlab, Inc., 489 Fifth Ave., New York 17, N. Y.
Avion Instrument Corp., Paramus, N. J.
Ballantine Laboratories, Inc., Boonton, N. J.
Bogue Electric Mfg. Co., 52 Iowa Ave., Paterson 3, N. J.
Brach Mfg. Corp., 200 Central Ave., Newark 4, N. J.
Consolidated Engineering Corp., 300 N. Sierra Madre Villa, Pasadena 8, Calif.
Elm Laboratories, 18 South Broadway, Dobbs Ferry, N. Y.
El-Tronics, Inc., 2649 N. Howard St., Philadelphia 33, Pa.
General Radio Co., 275 Massachusetts Ave., Cambridge 39, Mass.
Gulton Mfg. Corp., 212 Durham Ave., Metuchen, N. J.
Industrial Science Associates, 542 Fifth Ave., New York 19, N. Y.
Interelectronics Corp., 2432 Grand Concourse, New York 58, N. Y.
Jawil Electronics Inc., 7945 Germantown Ave., Philadelphia 18, Pa.
Leland Instruments Ltd., 22–23 Millbank, London, S. W. 1, England
Meipar Inc., 452 Swann Ave., Alexandria, Va.
Network Mfg. Corp., 215 W. 5th St., Bayonne, N. J.
Nuclear Specialty Co., P. O. Box 455, Center Moriches, N. Y.
Pacific Division, Bendix Aviation Corp., 11600 Sherman Way, North Hollywood, Calif.
Patterson, Moos & Co., Inc., 32–36 47th Ave., Long Island City 1, N. Y.
Phoenix Precision Instrument Co., 3803–05 W. 5th St., Philadelphia, Pa.
Sierra Electronic Corp., San Carlos, Calif.
SPENCER-KENNEDY LABS., INC., 186 Massachusetts Ave., Cambridge 39, Mass. ADV. PG. 12
Square Root Mfg. Corp., 391 Saw Mill River Rd., Yonkers, N. Y.
Sperry Gyroscope Co., Great Neck, N. Y.
Stephens Mfg. Corp., 8538 Warner Drive, Culver City, Calif.
T. L. G. Electric Corp., 31 W. 27th St., New York 1, N. Y.
Tech Laboratories, Inc., Bergen & Edsall Blvds., Palisades Park, N. J.
Telectro Industries Corp., 35–18 37th St., Long Island City 1, N. Y.
Thordarson-Meissner Mfg. Divs., Mt. Carmel, Ill.

AMPLIFIERS—Servo

Acme Electronics, Inc., 300 N. Lake Ave., Pasadena 4, Calif.
Air Associates, Inc., Teterboro, N. J.
American Communications Corp., 306 Broadway, New York 7, N. Y.
Atomlab, Inc., 489 Fifth Ave., New York 17, N. Y.
Audio Instrument Co., 113 W. 14th St., New York 11, N. Y.
Automatic Temperature Control Co., Inc., 5206 Pelaski Ave., Philadelphia 44, Pa.

Avion Instrument Corp., Paramus, N. J.
Bogue Electric Mfg. Co., 52 Iowa Ave., Paterson 3, N. J.
Bristol Co., The, Waterbury 20, Conn.
Dooleam Corp., 56 Elmwood St., Newton, Mass.
Eclipse-Pioneer Div., Bendix Aviation Corp., Teterboro, N. J.
Electrodyne Co., 32 Oliver St., Boston, Mass.
Engineering Research Associates, Inc., 1902 W. Minnehaha Ave., St. Paul 4, Minn.
Ford Instrument Co., 31-10 Thomson Ave., Long Island City, N. Y.
GENERAL ELECTRIC CO., Apparatus Sales Div., Schenectady 5, N. Y. ADV. PGS. 2-5
General Magnetics, Inc., 136 Bloomfield Ave., Bloomfield, N. J.
Highland Engineering Co., Main St. & Urban Ave., Westbury, N. Y.
Industrial Control Co., Straight Path & Arlington Ave., Wyandanch, N. Y.
Interelectronics Corp., 2432 Grand Concourse, New York 58, N. Y.
Krohn-Hite Instrument Co., 580 Massachusetts Ave., Cambridge 39, Mass.
Magnetic Amplifiers, Inc., 632 Tinton Ave., New York 55, N. Y.
McIntosh Engineering Laboratory, Inc., 320 Water St., Binghamton, N. Y.
MEASUREMENTS CORP., Boonton, N. J. ADV. PG. 96
Melpar Inc., 452 Swann Ave., Alexandria, Va.
MINNEAPOLIS-HONEYWELL REGULATOR CO., Wayne & Roberts Aves., Philadelphia 44, Pa. ADV. PG. 29
Muirhead & Co., Ltd., Beckenham, Kent, England
Nuclear Specialty Co., P. O. Box 455, Center Moriches, N. Y.
Pacific Division, Bendix Aviation Corp., 11600 Sherman Way, North Hollywood, Calif.
Phoenix Precision Instrument Co., 3803-05 N. 5th St., Philadelphia, Pa.
Plastics & Electronics Co., 272 Northland Ave., Buffalo 8, N. Y.
Reeves Instrument Corp., 215 E. 91st St., New York, N. Y.
Robinette Co., W. C., 802 Fair Oaks Ave., South Pasadena, Calif.
SANBORN CO., 39 Osborn St., Cambridge, Mass. ADV. PG. 92
Scott, Inc., Herman Hosmer, 385 Putnam Ave., Cambridge, Mass.
Servo Corp. of America, 2020 Jericho Turnpike, New Hyde Park, N. Y.
SERVOMECHANISMS, INC., Post & Stewart Aves., Westbury, N. Y. ADV. PG. 109
Specialties, Inc., Skunks Misery Road, Syosset, N. Y.
Square Root Mfg. Corp., 391 Saw Mill River Rd., Yonkers, N. Y.
Standard Electronics Research Corp., 2 East End Ave., New York 21, N. Y.
T. L. G. Electric Corp., 31 W. 27th St., New York 1, N. Y.
Thordarson-Meissner Mfg. Divs., Mt. Carmel, Ill.
TRANSICOIL CORP., 107 Grand St., New York 13, N. Y. ADV. PG. 17
Trans-Sonics, Inc., Bedford Airport, Bedford, Mass.
Vactron, Inc., 400 Main St., Waltham 54, Mass.
Vickers Electric Division, Vickers, Inc., 1815 Locust St., St. Louis, Mo.
Waltkirt Co., 145 W. Hazel, Inglewood, Calif.

AMPLIFIERS—Wideband

Advance Electronics Co., 451 Highland Ave., Passaic, N. J.
Airmec Laboratories, Ltd., High Wycombe, Buckinghamshire, England
Allied Radio Corp., 833 W. Jackson Blvd., Chicago 7, Ill.
American Communications Corp., 306 Broadway, New York 7, N. Y.
Atomlab, Inc., 489 Fifth Ave., New York 17, N. Y.
Audio Instrument Co., 133 W. 14th St., New York 11, N. Y.
Austin Co., Special Devices Div., 76 Ninth Ave., New York 11, N. Y.
Ballantine Laboratories, Inc., Boonton, N. J.
Bogue Electric Mfg. Co., 52 Iowa Ave., Paterson 3, N. J.
COLE, LTD., E. K., Electronics Div., Malmesbury, Wiltshire, England. ADV. PG. 28
DuMont Laboratories, Inc., Allen B., Instrument Div., 1000 Main Ave., Clifton, N. J.
El-Tronics, Inc., 2649 N. Howard St., Philadelphia 33, Pa.
Engineering Research Associates, Inc., 1902 W. Minnehaha Ave., St. Paul 4, Minn.
Fleming Radio Ltd., 18-20 Leystall St., London, E. C. 1, England
Ford Instrument Co., 31-10 Thomson Ave., Long Island City, N. Y.
FURST ELECTRONICS, 3322A W. Lawrence Ave., Chicago 25, Ill. ADV. PG. 110
Gaveco Labs., Inc., 2 East End Ave., New York 21, N. Y.
General Radio Co., 275 Massachusetts Ave., Cambridge 39, Mass.
Hewlett-Packard Co., 395 Page Mill Rd., Palo Alto, Calif.
Highland Engineering Co., Main St. & Urban Ave., Westbury, N. Y.
Leland Instruments Ltd., 22-23 Millbank, London, S. W. 1, England
McIntosh Engineering Laboratory, Inc., 320 Water St., Binghamton, N. Y.
Melpar Inc., 452 Swann Ave., Alexander, Va.
Network Mfg. Corp., 213 W. 5th St., Bayonne, N. J.
Newcomb Audio Products Co., 6824 Lexington Ave., Hollywood 38, Calif.
Nuclear Specialty Co., P. O. Box 455, Center Moriches, N. Y.
Polarad Electronics Corp., 100 Metropolitan Ave., Brooklyn 11, N. Y.
RADIATION INSTRUMENT DEVELOPMENT LAB., 2337 W. 67th St., Chicago 36, Ill. ADV. PG. Inside Back Cover
Rexdal Engineering, 2351 Riverside Drive, Los Angeles 39, Calif.
Ripley Co., Inc., 22 W. First St., Mt. Vernon, N. Y.
Rosen Engineering Products, Inc., Raymond, 32nd & Walnut St., Philadelphia 4, Pa.
Scott, Inc., Herman Hosmer, 385 Putnam Ave., Cambridge, Mass.
Sierra Electronic Corp., San Carlos, Calif.
SPENCER-KENNEDY LABS., INC., 186 Massachusetts Ave., Cambridge 39, Mass. ADV. PG. 12
Square Root Mfg. Corp., 391 Saw Mill River Rd., Yonkers, N. Y.
Standard Electronics Research Corp., 2 East End Ave., New York 21, N. Y.
Stephens Mfg. Corp., 8538 Warner Drive, Culver City, Calif.
Tech Laboratories, Inc., Bergen & Edsall Blvds., Palisades Park, N. J.
Technology Instrument Corp., 531 Main St., Acton, Mass.
Telechrome, Inc., Inc., 88 Merrick Road, Amityville, N. Y.
Telectro Industries Corp., 35-18 37th St., Long Island City 1, N. Y.
Tel-Instrument Co., 50 Patterson Ave., East Rutherford, N. J.
Thordarson-Meissner Mfg. Divs., Mt. Carmel, Ill.
U. S. Electronic Co., 262 Canner St., New Haven 11, Conn.
Waveforms, Inc., 333 Sixth Ave., New York 14, N. Y.

ANALYZERS—Coincidence and Anti-coincidence

ATOMIC INSTRUMENT CO., 84 Massachusetts Ave., Cambridge 39, Mass. ADV. PG. 23
Atomlab, Inc., 489 Fifth Ave., New York 17, N. Y.
Douglas Radio Labs., 176 Norfolk Ave., Boston 19, Mass.
Engineering Research Associates, Inc., 1902 W. Minnehaha Ave., St. Paul 4, Minn.
Gulton Mfg. Corp., 212 Durham Ave., Metuchen, N. J.
Macdonald Co., Inc., W. S., 33 University Rd., Cambridge 38, Mass.
MEASUREMENTS CORP., Boonton, N. J. ADV. PG. 96
NUCLEAR RESEARCH CORP., 2563 Grays Ferry Ave., Philadelphia 46, Pa. ADV. PG. 97
Nuclear Specialty Co., P. O. Box 455, Center Moriches, N. Y.
RADIATION INSTRUMENT DEVELOPMENT LAB., 2337 W. 67th St., Chicago 36, Ill. ADV. PG. Inside Back Cover
Telechrome, Inc., 88 Merrick Road, Amityville, N. Y.

ANALYZERS—Gas

American Oxygen Service Corp., 600 Essex St., Harrison, N. J.
Applied Physics Corp., 362 W. Colorado St., Pasadena 1, Calif.
Baird Associates, Inc., 33 University Rd., Cambridge 38, Mass.
Beckman, Inc., Arnold O., 1020 Mission St., South Pasadena, Calif.
CAMBRIDGE INSTRUMENT CO., INC., 3786 Grand Central Terminal, New York 17, N. Y. ADV. PG. 123
Consolidated Engineering Corp., 300 N. Sierra Madre Villa, Pasadena 8, Calif.
Davis Emergency Equipment Co., Inc., 252 Halleck St., Newark, N. J.
Daylight Vacuum Products Co., 5207 N. Milwaukee Ave., Chicago 30, Ill.
Fisher Scientific Co., 709 Forbes St., Pittsburgh 19, Pa.
Hays Corp., Michigan City, Ind.
Leeds & Northrup Co., 4970 Stenton Ave., Philadelphia 44, Pa.
Liston-Becker Instrument Co., Inc., 20 Beckley Ave., Stamford, Conn.
MINE SAFETY APPLIANCES CO., 201 N. Braddock Ave., Pittsburgh 21, Pa. ADV. PG. 130
NATIONAL RESEARCH CORP., 70 Memorial Drive, Cambridge 42, Mass. ADV. PG. 16
Ohmart Corp., The, 2347 Ferguson Ave., Cincinnati 38, Ohio
Perkin-Elmer Corp., Norwalk, Conn.
Permutit Co., 330 W. 42nd St., New York 36, N. Y.
Phipps & Bird, Inc., 303 S. 6th St., Richmond 5, Va.
Phoenix Precision Instrument Co., 3803-05 N. 5th St., Philadelphia, Pa.
Process & Instruments, 60 Greenpoint Ave., Brooklyn 22, N. Y.
Rubicon Co., Ridge Ave. at 35th St., Philadelphia 32, Pa.
Sargent & Co., E. H., 4647 W. Foster Ave., Chicago 30, Ill.
Scientific Glass Apparatus Co., Inc., 100 Lakewood Terrace, Bloomfield, N. J.
Sun Electric Corp., 6323 Avondale Ave., Chicago 31, Ill.
Vitro Corp. of America, 233 Broadway, New York 7, N. Y.

ANALYZERS—Pulse Height

ATOMIC INSTRUMENT CO., 84 Massachusetts Ave., Cambridge 39, Mass. ADV. PG. 23
Atomlab, Inc., 489 Fifth Ave., New York 17, N. Y.
Nuclear Specialty Co., P. O. Box 455, Center Moriches, N. Y.
RADIATION INSTRUMENT DEVELOPMENT LAB., 2337 W. 67th St., Chicago 36, Ill. ADV. PG. Inside Back Cover

APPARATUS—Distilling

American Copper & Brass Works, Inc., Cincinnati 2, Ohio
Barnstead Still & Sterilizer Co., 222 Lanesville Terrace, Forest Hills, Boston 31, Mass.
Brighton Copper Works, Inc., 2146 Colerain Ave., Cincinnati, Ohio
Corning Glass Works, Corning, N. Y.
Daylight Vacuum Products Co., 5207 N. Milwaukee Ave., Chicago 30, Ill.
DISTILLATION PRODUCTS INDUSTRIES, A Division of Eastman Kodak Co., Rochester 3, N. Y. ADV. PG. 91
Eberbach Corporation, Ann Arbor, Mich.
Electric Hotpack Co., Inc., 5035 Cottman Ave., Philadelphia, Pa.
Fisher Scientific Co., 709 Forbes St., Pittsburgh 19, Pa.
Glass Engineering Laboratories, Belmont, Calif.
General Mixing Equipment Co., 413 N. 3rd St., Philadelphia, Pa.
Jassonia Chemical Corp., 1085 Myrtle Ave., Brooklyn 6, N. Y.
KONTES GLASS CO., Spruce St., Vineland, N. J. ADV. PG. 126
Process & Instruments, 60 Greenpoint Ave., Brooklyn 22, N. Y.
Precision Scientific Co., 3737 W. Cortland St., Chicago 47, Ill.
Radiation Counter Labs., Inc., 1844 W. 21st St., Chicago 8, Ill.
Sargent & Co., E. H., 4647 W. Foster Ave., Chicago 30, Ill.
Scientific Glass Apparatus Co., Inc., 100 Lakewood Terrace, Bloomfield, N. J.
STOKES MACHINE CO., F. J., Frankford Station P. O., Philadelphia 20, Pa. ADV. PG. 117

APPARATUS—Drying (for use on gases)

American Oxygen Service Corp., 600 Essex St., Harrison, N. J.
Daylight Vacuum Products Co., 5207 Milwaukee Ave., Chicago 30, Ill.
Elsler Engineering Co., 730 S. 13th St., Newark 3, N. J.
Pittsburgh Lectrodryer Corp., P. O. Box 1766, Pittsburgh, Pa.
Scientific Glass Apparatus Co., Inc., 100 Lakewood Terrace, Bloomfield, N. J.
UNITED STATES TESTING CO., Hoboken, N. J. ADV. PG. 114

APPARATUS—Drying, Vacuum

Bowser Technical Refrigeration Div., Bowser, Inc., Terryville, Conn.
Daylight Vacuum Products Co., 5207 N. Milwaukee Ave., Chicago 30, Ill.
DISTILLATION PRODUCTS INDUSTRIES, A Division of Eastman Kodak Co., Rochester 3, N. Y. ADV. PG. 91
Electric Hotpack Co., Inc., 5035 Cottman St., Philadelphia, Pa.
Fredericks Co., George E., Bethayres, Pa.
KONTES GLASS CO., Spruce St., Vineland, N. J. ADV. PG. 126
National Appliance Co., Swan Island, Portland 18, Ore.
NATIONAL RESEARCH CORP., 70 Memorial Drive, Cambridge 42, Mass. ADV. PG. 16
OPTICAL FILM ENGINEERING CO., 2731-37 N. 6th St., Philadelphia 33, Pa. ADV. PG. 106
Phipps & Bird, Inc., 303 S. 6th St., Richmond 5, Va.
Scientific Glass Apparatus Co., Inc., 100 Lakewood Terrace, Bloomfield, N. J.
STOKES MACHINE CO., F. J., Frankford Station P. O., Philadelphia, Pa. ADV. PG. 117

Whittington Pump & Engineering Corp., 1126 Prospect St., Indianapolis 3, Ind.

APPARATUS—Filter Micro

Corning Glass Works, Corning, N. Y.
Daylight Vacuum Products Co., 5207 N. Milwaukee Ave., Chicago 30, Ill.
Fisher Scientific Co., 709 Forbes St., Pittsburgh 19, Pa.
KONTES GLASS CO., Spruce St., Vineland, N. J. ADV. PG. 126
Sargent & Co., E. H., 4647 W. Foster Ave., Chicago 30, Ill.
Scientific Glass Apparatus Co., Inc., 100 Lakewood Terrace, Bloomfield, N. J.

APPARATUS—Laboratory, Glass

ABLE SCIENTIFIC GLASS APPARATUS CO., 5041 W. Lake St., Chicago 44, Ill. ADV. POS. 106, 131, 134
Aloe Scientific Div. of A. S. Aloe Co., 5655 Kingsbury Blvd., St. Louis 12, Mo.
Central Scientific Co., 1700 Irving Park Rd., Chicago 13, Ill.
Consolidated Siphon Supply Co., Inc., 24 Wooster St., New York, N. Y.
Corning Glass Works, Corning, N. Y.
Daylight Vacuum Products Co., 5207 N. Milwaukee Ave., Chicago 30, Ill.
DISTILLATION PRODUCTS INDUSTRIES, A Division of Eastman Kodak Co., Rochester 3, N. Y. ADV. PG. 91
Elmer & Amend Div. of Fisher Scientific Co., 633 Greenwich St., New York, N. Y.
Fischer & Porter Co., 50 County Line Rd., Hatboro, Pa.
Fisher Scientific Co., 709 Forbes St., Pittsburgh 19, Pa.
Fredericks Co., George E., Bethayres, Pa.
Glass Engineering Laboratories, Belmont, Calif.
Huggins Laboratories, 734 Hamilton Ave., Menlo Park, Calif.
Jasonols Chemical Corp., 1085 Myrtle Ave., Brooklyn 6, N. Y.
Kahl Scientific Instrument Corp., Box 1166, El Cajon, Calif.
KONTES GLASS CO., Spruce St., Vineland, N. J. ADV. PG. 126
Milwaukee Glass Works, Inc., 2338 N. 30th St., Milwaukee, Wis.
Phoenix Precision Instrument Co., 3803-05 N. 5th St., Philadelphia, Pa.
Radioisotope Application Co., 1843 University Ave., Berkeley 3, Calif.
Sargent & Co., E. H., 4647 W. Foster Ave., Chicago 30, Ill.
Scientific Glass Apparatus Co., Inc., 100 Lakewood Terrace, Bloomfield, N. J.
Scientific Service, Inc., 1417 Solano Ave., Albany, Calif.
Special Glass Products Co., 2 W. 33rd St., New York, N. Y.
Thomas Co., Arthur H., W. Washington Square, Philadelphia 5, Pa.
Wakefield Industries, Inc., 5108 Grove St., Skokie, Ill.

APPARATUS—Laboratory, Platinum

Baker & Co., Inc., 113 Astor St., Newark 5, N. J.
Bishop & Co., J., Malvern, Pa.
Daylight Vacuum Products Co., 5207 N. Milwaukee Ave., Chicago 30, Ill.
Kling Metal Spinning Co., 174 Centre St., New York 13, N. Y.
Thomas Co., Arthur H., W. Washington Square, Philadelphia 5, Pa.

APPARATUS—Laboratory, Porcelain

Coors Porcelain Co., Golden, Colo.
Thomas Co., Arthur H., W. Washington Square, Philadelphia 5, Pa.
U. S. Stoneware Co., Akron 9, Ohio

APPARATUS—Micro-Drying

Daylight Vacuum Products Co., 5207 N. Milwaukee Ave., Chicago 30, Ill.
Fisher Scientific Co., 709 Forbes St., Pittsburgh 19, Pa.
Phipps & Bird, Inc., 303 S. 6th St., Richmond 5, Va.
Sargent & Co., E. H., 4647 Foster Ave., Chicago 30, Ill.
Scientific Glass Apparatus Co., Inc., 100 Lakewood Terrace, Bloomfield, N. J.

APRONS

American Optical Co., Southbridge, Mass.
Colloid Equipment Co., Inc., 50 Church St., New York, N. Y.
Fisher Scientific Co., 709 Forbes St., Pittsburgh 19, Pa.
Goodrich Co., B. F., Akron, Ohio
MINE SAFETY APPLIANCES CO., 201 N. Braddock Ave., Pittsburgh 21, Pa. ADV. PG. 130
U. S. Rubber Co., 1230 Avenue of the Americas, New York 20, N. Y.

ASBESTOS—Filtering

Asbestos Textile Co., 165 Wacker Drive, Chicago 1, Ill.
Consolidated Siphon Supply Co., Inc., 24 Wooster St., New York, N. Y.
Fisher Scientific Co., 709 Forbes St., Pittsburgh 19, Pa.

ASHING DISHES

Corning Glass Works, Corning, N. Y.
Kling Metal Spinning Co., 174 Centre St., New York 13, N. Y.
TRACERLAB, INC., 130 High St., Boston 10, Mass. ADV. PG. 24

ASPIRATOR UNITS

Boekel & Co., Inc., Wm., 509-519 Vine St., Philadelphia 6, Pa.
Phillips-Drucker, 2245 S. Vandeventer Ave., St. Louis, Mo.
Sargent & Co., E. H., 4647 W. Foster Ave., Chicago 30, Ill.
Scientific Glass Apparatus Co., Inc., 100 Lakewood Terrace, Bloomfield, N. J.

ATOMIZING EQUIPMENT

Phoenix Precision Instrument Co., 3803-05 N. 5th St., Philadelphia, Pa.

AUTOCLAVES

Aetna Scientific Co., Second & Spring Sts., Everett 49, Mass.
Aloe Scientific Div. of A. S. Aloe Co., 5655 Kingsbury Blvd., St. Louis 12, Mo.
Babcock & Wilcox Co., 161 E. 42nd St., New York 17, N. Y.
Barnstead Still & Sterilizer Co., 222 Lanesville Terrace, Forest Hills, Boston 31, Mass.
Boekel & Co., Inc., Wm., 509-519 Vine St., Philadelphia 6, Pa.
General Mixing Equipment Co., 413 N. 3rd St., Philadelphia, Pa.
Glas-Col Apparatus Co., Inc., 711 Hulman St., Terre Haute, Ind.
Leader Iron Works, Inc., 2110 N. Jasper, Decatur, Ill.
Patterson-Kelley Co., Inc., East Stroudsburg, Pa.
Pelton & Crane Co., 632 Harper Ave., Detroit, Mich.
Pfaudler Co., 1002 West Ave., Rochester, N. Y.
Precision Scientific Co., 3737 W. Cortland St., Chicago 47, Ill.
Struthers-Wells Corp., Warren, Pa.

BADGES—Film

Atomlab, Inc., 489 Fifth Ave., New York 17, N. Y.
BAR-RAY PRODUCTS, INC., 209 25th St., Brooklyn 32, N. Y. ADV. PG. 112
ISOTOPE SPECIALTIES CO., 3816 San Fernando Rd., Glendale, Calif. ADV. PG. 94
R-C SCIENTIFIC INSTRUMENT CO., 335 Culver Blvd., Playa Del Rey, Calif. ADV. PG. 129
Samples Machine Co., A. M., 506 N. Central Ave., Knoxville, Tenn.
TECHNICAL ASSOCIATES, INC., 140 W. Providencia Ave., Burbank, Calif. ADV. PG. 130
TRACERLAB, INC., 130 High St., Boston 10, Mass. ADV. PG. 24

BALANCES—Analytical

American Instrument Co., Inc., 8030 Georgia Ave., Silver Spring, Md.
Colloid Equipment Co., Inc., 50 Church St., New York 7, N. Y.
Fisher Scientific Co., 709 Forbes St., Pittsburgh 19, Pa.
Jarrell-Ash Co., 165 Newberry St., Boston 16, Mass.
Roller-Smith Corp., 1000 Eighth Ave., Bethlehem, Pa.
Yonkers Laboratory Supply Co., 70 Palisade Ave., Yonkers 2, N. Y.

BALANCES—Heavy Duty

Central Scientific Co., 1700 Irving Park Rd., Chicago 13, Ill.
Colloid Equipment Co., Inc., 50 Church St., New York 7, N. Y.
Fisher Scientific Co., 709 Forbes St., Pittsburgh 19, Pa.
Humboldt Mfg. Co., 2814 N. Whipple St., Chicago 47, Ill.
Ohaus Scale Corp., 1050 Commerce Ave., Union, N. J.

BALANCES—Microchemical

Fisher Scientific Co., 709 Forbes St., Pittsburgh 19, Pa.
Jarrell-Ash Co., 165 Newberry St., Boston 16, Mass.
Yonkers Laboratory Supply Co., 70 Palisade Ave., Yonkers 2, N. Y.

BALANCES—Scale, Analytical

American Instrument Co., Inc., 8030 Georgia Ave., Silver Spring, Md.
Colloid Equipment Co., Inc., 50 Church St., New York 7, N. Y.
Fisher Scientific Co., 709 Forbes St., Pittsburgh 19, Pa.
Jarrell-Ash Co., 165 Newberry St., Boston 16, Mass.
Roller-Smith Corp., 1000 Eighth Ave., Bethlehem, Pa.
Yonkers Laboratory Supply Co., 70 Palisade Ave., Yonkers 2, N. Y.

BALANCES—Semi-Micro

Fisher Scientific Co., 709 Forbes St., Pittsburgh 19, Pa.
Jarrell-Ash Co., 165 Newberry St., Boston 16, Mass.

BALANCES—Spring

Colloid Equipment Co., Inc., 50 Church St., New York 7, N. Y.
Welch Scientific Co., W. M., 1515 Sedgwick St., Chicago 10, Ill.

BALANCES—Torsion

American Instrument Co., Inc., 8030 Georgia Ave., Silver Spring, Md.
Colloid Equipment Co., Inc., 50 Church St., New York 7, N. Y.
Humboldt Mfg. Co., 2814 N. Whipple St., Chicago 47, Ill.
Ohaus Scale Corp., 1050 Commerce Ave., Union, N. J.
Roller-Smith Corp., 1000 Eighth Ave., Bethlehem, Pa.
Special Instruments Laboratory, Inc., 1003 Highland Ave., Knoxville, Tenn.
Welch Scientific Co., W. M., 1515 Sedgwick St., Chicago 10, Ill.
Yonkers Laboratory Supply Co., 70 Palisade Ave., Yonkers 2, N. Y.

BALL MILLS

Allis Chalmers Mfg. Co., 935 S. 70th St., Milwaukee 1, Wis.
Babcock & Wilcox Co., 161 E. 42nd St., New York 17, N. Y.
Elster Engineering Co., 760 S. 13th St., Newark 3, N. J.
Fisher Scientific Co., 709 Forbes St., Pittsburgh 19, Pa.
General Mixing Equipment Co., 413 N. 3rd St., Philadelphia, Pa.
Gulton Mfg. Corp., 212 Durham Ave., Metuchen, N. J.
Hammel Co., O., 209-213 Fourth Ave., Pittsburgh, Pa.
International Engineering, Inc., 1200 Balander Ave., Dayton, Ohio
U. S. Stoneware Co., Akron 9, Ohio

BALLOONS

AERONAUTICAL RESEARCH LABS., GENERAL MILLS, INC., 2010 E. Hennepin Ave., Minneapolis 13, Minn. ADV. PG. 99
Scientific Glass Apparatus Co., Inc., 100 Lakewood Terrace, Bloomfield, N. J.

BAROMETERS

Bristol Co., The, Waterbury 20, Conn.
Central Scientific Co., 1700 Irving Park Rd., Chicago 13, Ill.
Eberbach Corporation, Ann Arbor, Mich.
Fisher Scientific Co., 709 Forbes St., Pittsburgh 19, Pa.
Manning, Maxwell & Moore, Inc., Stratford, Conn.
Sargent & Co., E. H., 4647 W. Foster Ave., Chicago 30, Ill.
Wallace & Tiernan Products, Inc., Belleville 9, N. J.
Welch Scientific Co., W. M., 1515 Sedgwick St., Chicago 10, Ill.
WESTON ELECTRICAL INSTRUMENT CORP., 614 Frelinghuysen Ave., Newark 5, N. J. ADV. PG. 102

BATHS—Constant Temperature

Aloe Scientific Div. of A. S. Aloe Co., 5655 Kingsbury Blvd., St. Louis 12, Mo.
Boekel & Co., Inc., Wm., 509-519 Vine St., Philadelphia 6, Pa.
Electric Heat Control Apparatus Co., 27 N. J. R. R. Ave., Newark 5, N. J.
Electric Hotpack Co., Inc., 5035 Cottman Ave., Philadelphia, Pa.

Emerson-Sack-Warner Corp., 150 Dorchester Ave., South Boston 23, Mass.
Fisher Scientific Co., 709 Forbes St., Pittsburgh 19, Pa.
Leeds & Northrup Co., 4970 Stenton Ave., Philadelphia 44, Pa.
Metal Products Corp., 48 W. 19th St., Weehawken, N. J.
Phipps & Bird, Inc., 303 S. 6th St., Richmond 5, Va.
Precision Scientific Co., 3737 W. Cortland St., Chicago 47, Ill.
Process & Instruments, 60 Greenpoint Ave., Brooklyn 22, N. Y.
Radioisotope Application Co., 1843 University Ave., Berkeley 3, Calif.
Sargent & Co., E. H., 4647 W. Foster Ave., Chicago 30, Ill.
Scientific Service, Inc., 1417 Solano Ave., Albany, Calif.
Standard Cabinets Co., 52 Washington Ave., Carlstadt, N. J.
Standard Electronics Research Corp., 2 East End Ave., New York 21, N. Y.
Thomas Co., Arthur H., W. Washington Square, Philadelphia 5, Pa.
Yonkers Laboratory Supply Co., 70 Palisade Ave., Yonkers 2, N. Y.

BATTERIES

Allied Radio Corp., 833 W. Jackson Blvd., Chicago 7, Ill.
Bright Star Battery Co., 200 Crooks Ave., Clifton, N. J.
Burgess Battery Co., Battery Div., Freeport, Ill.
Goodyear Tire & Rubber Co., Akron, Ohio
Interelectronics Corp., 2432 Grand Concourse, New York 58, N. Y.
Kellogg Switchboard & Supply Co., 79 W. Monroe, Chicago 3, Ill.
Mallory & Co., Inc., P. R., 3029 E. Washington St., Indianapolis 6, Ind.
National Carbon Co., A Division of Union Carbide & Carbon Corp., 30 E. 42nd St., New York 17, N. Y.
NUCLEAR INSTRUMENT & CHEMICAL CORP., 223 W. Erie St., Chicago 10, Ill. ADV. PG. Back Cover
RADIO CORP. OF AMERICA, TUBE DEPT., Harrison, N. J. ADV. PG. 93
Ray-O-Vac Co., Madison, Wisconsin
Specialty Battery Co., Madison 4, Wisconsin

BATTERIES—Nuclear

Ohmart Corp., The, 2347 Ferguson Ave., Cincinnati 38, Ohio

BEARINGS—Miniature

Landis & Gyr, Inc., 104 Fifth Ave., New York 11, N. Y.
Miniature Precision Bearings, Inc., Keene, N. H.
Neo-Sil Corp., 26 Cornelison Ave., Jersey City 4, N. J.
Polymer Corp. of Penna., The, Reading, Pa.

BELLOWS

Bohn Wood Products Co., Route 30 E, Fort Wayne, Ind.
Daylight Vacuum Products Co., 5207 N. Milwaukee Ave., Chicago 30, Ill.
Fulton Sylphon Division, Robertshaw-Fulton Controls Co., Knoxville 4, Tenn.
U. S. GASKET CO., 602 N. 10th St., Camden, N. J. ADV. PG. 135
Zallea Brothers, 800 Locust St., Wilmington, Del.

BENCHES

Alce Scientific Div. of A. S. Alce Co., 5655 Kingsbury Blvd., St. Louis 12, Mo.
American Optical Co., Southbridge, Mass.
BAR-RAY PRODUCTS, INC., 209 25th St., Brooklyn 32, N. Y. ADV. PG. 112
Brooklyn Hospital Equipment Co., Inc., 196 Lexington Ave., New York, N. Y.
Felstrom Co., 7 Felstrom Court, Passaic, N. J.
Fisher Scientific Co., 709 Forbes St., Pittsburgh 19, Pa.
Harford Metal Products, Inc., P. O. Box 459, Aberdeen, Md.
Lyon Metal Products, Inc., 10 Montgomery St., Aurora, Ill.
Metalab Equipment Corp., 270 Duffy Ave., Hicksville, N. Y.
Radioisotope Application Co., 1843 University Ave., Berkeley 3, Calif.
Scientific Service, Inc., 1417 Solano Ave., Albany, Calif.
Sheldon Equipment Co., E. H., Muskegon, Mich.

BI-METALS—Thermostatic

American Silver Co., 36-07 Prince St., Flushing, N. Y.
Baker & Co., Inc., 113 Astor St., Newark 5, N. J.
BAR-RAY PRODUCTS, INC., 209 25th St., Brooklyn 32, N. Y. ADV. PG. 112
Bishop & Co., J., Malvern, Pa.
Emerson-Sack-Warner Corp., 150 Dorchester Ave., South Boston 23, Mass.
Manning, Maxwell & Moore, Inc., Stratford, Conn.
Sargent & Co., E. H., 4647 W. Foster Ave., Chicago 30, Ill.
Welch Scientific Co., W. M., 1515 Sedgwick St., Chicago 10, Ill.

BLENDERS—Laboratory

Alce Scientific Div. of A. S. Alce Co., 5655 Kingsbury Blvd., St. Louis 12, Mo.
Central Scientific Co., 1700 Irving Park Rd., Chicago 13, Ill.
Colloid Equipment Co., Inc., 50 Church St., New York 7, N. Y.
Consolidated Siphon Supply Co., Inc., 24 Wooster St., New York, N. Y.
Lapp Insulator Co., Inc., 31 Gilbert St., LeRoy, N. Y.
Patterson-Kelley Co., Inc., East Stroudsburg, Pa.
Sargent & Co., E. H., 4647 W. Foster Ave., Chicago 30, Ill.
U. S. Stoneware Co., Akron 9, Ohio

BLOWERS—Laboratory

American Electric Motors, Inc., 4811-13 Telegraph Rd., Los Angeles, Calif.
American Vacuum Co., 816 S. Michigan Ave., Chicago, Ill.
Century Fan & Ventilator Co., 25 Cedar St., Stamford, Conn.
Clarage Fan Co., 719 Porter St., Kalamazoo, Mich.
Dayton Electric Mfg. Co., 748 W. Adams, Chicago, Ill.
Eberbach Corporation, Ann Arbor, Mich.
Eisler Engineering Co., 760 S. 13th St., Newark 3, N. J.
Electric Blower Co., 350 Atlantic Ave., Boston, Mass.
Electrovent Fan & Mfg. Co., 812 W. Lake St., Chicago 7, Ill.
Fasco Industries, Inc., Rochester 2, N. Y.
Hamilton Mfg. Co., Two Rivers, Wis.
Ilg Electric Ventilating Co., 2850 N. Crawford Ave., Chicago 41, Ill.
Mission Electric Mfg. Co., Inc., 132-134 W. Colorado, Pasadena 1, Calif.
Redmond Co., Inc., Owosso, Mich.
Ripley Co., Inc., 22 W. First St., Mt. Vernon, N. Y.
Rotron Mfg. Co., 7 Schoonmaker Lane, Woodstock, N. Y.
Sanders Associates, Inc., Nashua, N. H.
Small Motors, Inc., 2076 Elston Ave., Chicago 14, Ill.
Trane Co., La Crosse, Wis.
United States Air Conditioning Corp., Como Ave., SE at 33rd, Minneapolis 14, Minn.
Western Blower Co., 1800 Airport Way, Seattle 66, Wash.
Westinghouse Electric Corp., P. O. Box 868, Pittsburgh 30, Pa.

BOTTLES

(See Containers)

BOXES—Dry Ice

Cutler Metal Products Co., Camden, N. J.
Durlach Can & Iron Works, 168 7th, Brooklyn, N. Y.
Emerson-Sack-Warner Corp., 150 Dorchester Ave., South Boston 23, Mass.
Northern-Zaleski, Ltd., Pratt Oval, Glen Cove, N. Y.
Tenney Engineering, Inc., 26 Avenue B, Newark 5, N. J.

BOXES—Glove

Alce Scientific Div. of A. S. Alce Co., 5655 Kingsbury Blvd., St. Louis 12, Mo.
BLICKMAN, INC., S., 7900 Gregory Ave., Weehawken, N. J. ADV. PG. 30
Cutler Metal Products Co., Camden, N. J.
Kewaunee Mfg. Co., 5083 S. Center St., Adrian, Mich.
RADIATION INSTRUMENT DEVELOPMENT LAB., 2337 W. 67th St., Chicago 36, Ill. ADV. PG. Inside Back Cover
Radioisotope Application Co., 1843 University Ave., Berkeley 3, Calif.
Scientific Service, Inc., 1417 Solano Ave., Albany, Calif.

BRACKETS

Durlach Can & Iron Works, 168 7th, Brooklyn, N. Y.
Emerson-Sack-Warner Corp., 150 Dorchester Ave., South Boston 23, Mass.
Felstrom Co., 7 Felstrom Court, Passaic, N. J.
Keystone Electronics Corp., 423 Broome St., New York 13, N. Y.
South River Metal Products Co., Inc., 377-379 Turnpike, South River, N. J.
York Clock Co., Inc., Mount Vernon, N. Y.

BRICK—Acid Resisting

Acme Brick Co., P. O. Box 425, Fort Worth 2, Texas
Atlas Mineral Products Co., 131 Norman St., Mertztown, Pa.
Division Lead Co., 836 W. Kinzie St., Chicago 22, Ill.
Electro Chemical Supply & Engineering Co., 750 Broad St., Emmaus, Pa.
General Ceramics & Steatite Corp., 250 Crows Mill Rd., Keasbey, N. J.
Hommel Co., O., 209-213 Fourth Ave., Pittsburgh, Pa.
Knight, Maurice A., 171 Kelly Ave., Akron, Ohio
Kraftile Co., Niles, Calif.
Lapp Insulator Co., Inc., 31 Gilbert St., LeRoy, N. Y.
TECHNICAL ASSOCIATES, INC., 140 W. Providencia Ave., Burbank, Calif. ADV. PG. 130
Toronto Fire Brick Co., Toronto, Ohio
United Materials & Richmond Brick Co., Ltd., Pt. Richmond, Calif.
U. S. Stoneware Co., Akron 9, Ohio

BRIDGES—Conductivity

American Instrument Co., Inc., 8030 Georgia Ave., Silver Spring, Md.
Barnes Development Co., 213 W. Baltimore Pike, Lansdowne, Pa.
Bristol Co., The, Waterbury 20, Conn.
CAMBRIDGE INSTRUMENT CO., INC., 3786 Grand Central Terminal, New York 17, N. Y. ADV. PG. 123
Electrodyne Co., 32 Oliver St., Boston, Mass.
Industrial Instruments, Inc., 89 Commerce Rd., Cedar Grove, N. J.
Kahl Scientific Instrument Corp., Box 1166, El Cajon, Calif.
Leeds & Northrup Co., 4970 Stenton Ave., Philadelphia 44, Pa.
Rubicon Co., Ridge Ave. at 35th St., Philadelphia 32, Pa.
Square Root Mfg. Corp., 391 Saw Mill River Rd., Yonkers, N. Y.
Vectron, Inc., 400 Main St., Waltham 54, Mass.
Wayne-Kerr Laboratories, Inc., New Malden, Surrey, England
Winslow Co., Inc., 9 Liberty St., Newark, N. J.

BRIDGES—Electrical

Allied Radio Corp., 833 W. Jackson Blvd., Chicago 7, Ill.
Barnes Development Co., 213 W. Baltimore Pike, Lansdowne, Pa.
Bristol Co., The, Waterbury 20, Conn.
Brown Electro-Measurement Corp., 4637 SE Hawthorne Blvd., Portland 15, Ore.
CAMBRIDGE INSTRUMENT CO., INC., 3786 Grand Central Terminal, New York 17, N. Y. ADV. PG. 123
Cinema-Television Ltd., Worsley Bridge Rd., London, S. E. 26, England
Clough Brengle Co., 6014 N. Broadway, Chicago, Ill.
Cole Instrument Co., 1320 S. Grand Ave., Los Angeles 15, Calif.
Cossor (Canada) Ltd., 301 Windsor St., Halifax, N. S., Canada
Electric & Musical Industries Ltd., Hayes, Middlesex, England
Electrodyne Co., 32 Oliver St., Boston, Mass.
Electro-Mec Laboratory, 19 Murray St., New York 7, N. Y.
Elm Laboratories, 18 South Broadway, Dobbs Ferry, N. Y.
Fisher Scientific Co., 709 Forbes St., Pittsburgh 19, Pa.
Freed Transformer Co., Inc., 1736 Weirfield St., Brooklyn 27, N. Y.
Gavaco Labs., Inc., 2 East End Ave., New York 21, N. Y.
General Radio Co., 275 Massachusetts Ave., Cambridge 39, Mass.
Instrument Laboratories, 315 W. Walton Place, Chicago, Ill.
Leeds & Northrup Co., 4970 Stenton Ave., Philadelphia 44, Pa.
Leland Instruments Ltd., 22-23 Millbank, London, S. W. 1, England
Marconi Instruments Ltd., 23-25 Beaver St., New York 4, N. Y.
MEASUREMENTS CORP., Boonton, N. J. ADV. PG. 96
Network Mfg. Corp., 213 W. 5th St., Bayonne, N. J.
Polytechnic Research & Development Co., 55 Johnson St., Brooklyn 1, N. Y.
Rubicon Co., Ridge Ave. at 35th St., Philadelphia 32, Pa.
Sierra Electronic Corp., San Carlos, Calif.
Square Root Mfg. Corp., 391 Saw Mill River Rd., Yonkers, N. Y.
Tech Laboratories, Inc., Bergen & Edsall Blvds., Palisades Park, N. J.
Technology Instrument Corp., 531 Main St., Acton, Mass.
Vectron, Inc., 400 Main St., Waltham 54, Mass.

VICTOREEN INSTRUMENT CO., 3800 Perkins Ave., Cleveland 14, Ohio. ADV. PG. Inside Front Cover
Wayne-Kerr Laboratories, Inc., New Malden, Surrey, England
Welch Scientific Co., W. M., 1515 Sedgwick St., Chicago 10, Ill.
Western Sound & Electric Labs., Inc., 805 S. Fifth St., Milwaukee 4, Wis.
Winslow Co., Inc., 9 Liberty St., Newark, N. J.

BRIDGES—Temperature

Barnes Development Co., 213 W. Baltimore Pike, Lansdowne, Pa.
Bristol Co., The, Waterbury 20, Conn.
Electrodyne Co., 32 Oliver St., Boston, Mass.
Fisher Scientific Co., 709 Forbes St., Pittsburgh 19, Pa.
Kahl Scientific Instrument Corp., Box 1166, El Cajon, Calif.
Leeds & Northrup Co., 4970 Stenton Ave., Philadelphia 44, Pa.
Pyrometer Instrument Co., Inc., Bergenfield, N. J.
Rubicon Co., Ridge Ave. at 35th St., Philadelphia 32, Pa.
Square Root Mfg. Corp., 391 Saw Mill River Rd., Yonkers, N. Y.
Trans-Sonics, Inc., Bedford Airport, Bedford, Mass.
Vectron, Inc., 400 Main St., Waltham 54, Mass.
Winslow Co., Inc., 9 Liberty St., Newark, N. J.

BRIDGES—Wheatstone

Baldwin Instrument Co., Ltd., Brooklands Works, Dartford, Kent, England
Barnes Development Co., 213 W. Baltimore Pike, Lansdowne, Pa.
Bristol Co., The, Waterbury 20, Conn.
Brown Electro-Measurement Corp., 4637 SE Hawthorne Blvd., Portland 15, Ore.
CAMBRIDGE INSTRUMENT CO., INC., 3786 Grand Central Terminal, New York 17, N. Y. ADV. PG. 123
Electrodyne Co., 32 Oliver St., Boston, Mass.
Electro-Mec Laboratory, 19 Murray St., New York 7, N. Y.
Fisher Scientific Co., 709 Forbes St., Pittsburgh 19, Pa.
General Radio Co., 275 Massachusetts Ave., Cambridge 39, Mass.
Industrial Instruments, Inc., 89 Commerce Rd., Cedar Grove, N. J.
Instrument Laboratories, 315 W. Walton Place, Chicago, Ill.
Leeds & Northrup Co., 4970 Stenton Ave., Philadelphia 44, Pa.
Leland Instruments Ltd., 22–23 Millbank, London, S. W. 1, England
Rubicon Co., Ridge Ave. at 35th St., Philadelphia 32, Pa.
Shaltcross Mfg. Co., 10 Jackson Ave., Collingdale, Pa.
Southwestern Industrial Electronics Co., 2831 Post Oak Rd., P. O. Box 13058, Houston 19, Texas
Special Instruments Laboratory, Inc., 1003 Highland Ave., Knoxville, Tenn.
Square Root Mfg. Corp., 391 Saw Mill River Rd., Yonkers, N. Y.
Sticht, Inc., Herman H., 27 Park Place, New York 7, N. Y.
Tech Laboratories, Inc., Bergen & Edsall Blvds., Palisades Park, N. J.
Trans-Sonics, Inc., Bedford Airport, Bedford, Mass.
Vectron, Inc., 400 Main St., Waltham 54, Mass.
Welch Scientific Co., W. M., 1515 Sedgwick St., Chicago 10, Ill.
Western Sound & Electric Labs., Inc., 805 S. Fifth St., Milwaukee 4, Wis.
Winslow Co., Inc., 9 Liberty St., Newark, N. J.

BRIQUETTING PRESS

Jarrell-Ash Co., 165 Newberry St., Boston 16, Mass.

BURETTES

Corning Glass Works, Corning, N. Y.
Fisher Scientific Co., 709 Forbes St., Pittsburgh 19, Pa.
Fredericks Co., George E., Bethayres, Pa.
Hays Corp., Michigan City, Ind.
Jarrell-Ash Co., 165 Newberry St., Boston 16, Mass.
KONTES GLASS CO., Spruce St., Vineland, N. J. ADV. PG. 126
Milwaukee Glass Works, Inc., 2338 N. 30th St., Milwaukee, Wis.
Precision Scientific Co., 3737 W. Cortland St., Chicago 47, Ill.
Sargent & Co., E. H., 4647 W. Foster Ave., Chicago 30, Ill.
Scientific Glass Apparatus Co., Inc., 100 Lakewood Terrace, Bloomfield, N. J.
Special Glass Products Co., 2 W. 33rd St., New York, N. Y.
Yonkers Laboratory Supply Co., 70 Palisade Ave., Yonkers 2, N. Y.

BURETTES—Automatic

Daylight Vacuum Products Co., 5207 N. Milwaukee Ave., Chicago 30, Ill.
Fisher Scientific Co., 709 Forbes St., Pittsburgh 19, Pa.
Kahl Scientific Instrument Corp., Box 1166, El Cajon, Calif.
KONTES GLASS CO., Spruce St., Vineland, N. J. ADV. PG. 126
Milwaukee Glass Works, Inc., 2338 N. 30th St., Milwaukee, Wis.
Sargent & Co., E. H., 4647 W. Foster Ave., Chicago 30, Ill.
Scientific Glass Apparatus Co., Inc., 100 Lakewood Terrace, Bloomfield, N. J.
Special Glass Products Co., 2 W. 33rd St., New York, N. Y.
Yonkers Laboratory Supply Co., 70 Palisade Ave., Yonkers 2, N. Y.

BURNERS—Blast

Central Scientific Co., 1700 Irving Park Rd., Chicago 13, Ill.
Daylight Vacuum Products Co., 5207 N. Milwaukee Ave., Chicago 30, Ill.
Eclipse Fuel Engineering Co., 705 S. Main St., Rockford, Ill.
Eisler Engineering Co., 760 S. 13th St., Newark 3, N. J.
Fisher Scientific Co., 709 Forbes St., Pittsburgh 19, Pa.
Humboldt Mfg. Co., 2814 N. Whipple St., Chicago 47, Ill.
Precision Scientific Co., 3737 W. Cortland St., Chicago 47, Ill.
Sargent & Co., E. H., 4647 W. Foster Ave., Chicago 30, Ill.

BURNERS—Cross-Fire

Eisler Engineering Co., 760 S. 13th St., Newark 3, N. J.
Precision Scientific Co., 3737 W. Cortland St., Chicago 47, Ill.
Sargent & Co., E. H., 4647 W. Foster Ave., Chicago 30, Ill.

BURNERS—Gas Hot Plate

Precision Scientific Co., 3737 W. Cortland St., Chicago 47, Ill.

BURNERS—Laboratory

Bookal & Co., Inc., Wm., 509–519 Vine St., Philadelphia 6, Pa.
Central Scientific Co., 1700 Irving Park Rd., Chicago 13, Ill.
Eclipse Fuel Engineering Co., 705 S. Main St., Rockford, Ill.
Eimer & Amend, Div. of Fisher Scientific Co., 635 Greenwich St., New York, N. Y.
Eisler Engineering Co., 760 S. 13th St., Newark 3, N. J.
Fisher Mfg. Co., Inc., John C., 37–29 9th St., Long Island City 1, N. Y.
Fisher Scientific Co., 709 Forbes St., Pittsburgh 19, Pa.
Humboldt Mfg. Co., 2814 N. Whipple St., Chicago 47, Ill.
Linde Air Products Co., Div. of Union Carbide & Carbon Corp., 30 E. 42nd St., New York 17, N. Y.
Precision Scientific Co., 3737 W. Cortland St., Chicago 47, Ill.
Sargent & Co., E. H., 4647 W. Foster Ave., Chicago 30, Ill.
Welch Scientific Co., W. M., 1515 Sedgwick St., Chicago 10, Ill.
Will Corp., Rochester 3, N. Y.
Yonkers Laboratory Supply Co., 70 Palisade Ave., Yonkers 2, N. Y.

BURNERS—Micro

Bookal & Co., Inc., Wm., 509–519 Vine St., Philadelphia 6, Pa.
Central Scientific Co., 1700 Irving Park Rd., Chicago 13, Ill.
Fisher Mfg. Co., Inc., John C., 37–29 9th St., Long Island City 1, N. Y.
Fisher Scientific Co., 709 Forbes St., Pittsburgh 19, Pa.
Humboldt Mfg. Co., 2814 N. Whipple St., Chicago 47, Ill.
Precision Scientific Co., 3737 W. Cortland St., Chicago 47, Ill.
Sargent & Co., E. H., 4647 W. Foster Ave., Chicago 30, Ill.
Thomas Co., Arthur H., W. Washington Square, Philadelphia 5, Pa.
Welch Scientific Co., W. M., 1515 Sedgwick St., Chicago 10, Ill.
Yonkers Laboratory Supply Co., 70 Palisade Ave., Yonkers 2, N. Y.

BURNERS—Quartz

Cooper-Hewitt Electric Co., 721 Grand St., Hoboken, N. J.
Eclipse Fuel Engineering Co., 705 S. Main St., Rockford, Ill.
Eisler Engineering Co., 760 S. 13th St., Newark 3, N. J.
Hanovia Chemical & Mfg. Co., 233 N. J. R. R. Ave., Newark 5, N. J.
Menlo Research Laboratory, Menlo Park, Calif.

BUSHINGS—Hermetically Sealed

Daylight Vacuum Products Co., 5207 N. Milwaukee Ave., Chicago 30, Ill.
General Ceramics & Steatite Corp., 250 Crows Mill Rd., Keasbey, N. J.
Hermetic Seal Products Co., 29–37 6th St., Newark, N. J.
Neo-Sil Corp., 26 Cornelison Ave., Jersey City 4, N. J.

CABINETS—Drying

BAR-RAY PRODUCTS, INC., 209 25th St., Brooklyn 32, N. Y. ADV. PG. 113
Bookal & Co., Inc., Wm., 509–519 Vine St., Philadelphia 6, Pa.
Bristol Metal Products Corp., Bristol, Tenn.
Brooklyn Hospital Equipment Co., Inc., 196 Lexington Ave., New York, N. Y.
Cutler Metal Products Co., Camden, N. J.
Durlach Can & Iron Works, 168 7th, Brooklyn, N. Y.
Electric Hotpack Co., Inc., 5035 Cottman Ave., Philadelphia, Pa.
Emerson-Sack-Warner Corp., 150 Dorchester Ave., South Boston 23, Mass.
Laboratory Furniture Co., Inc., P. O. Box 590, Mineola, N. Y.
Metal Products Corp., 48 W. 19th St., Weehawken, N. J.
Metalab Equipment Corp., 270 Duffy Ave., Hicksville, N. Y.
National Appliance Co., Swan Island, Portland 18, Ore.
NATIONAL RESEARCH CORP., 70 Memorial Drive, Cambridge 42, Mass. ADV. PG. 16
Pabst Engineering Equipment Co., Inc., Elizabeth, N. J.
Phipps & Bird, Inc., 303 S. 6th St., Richmond 5, Va.
Precision Scientific Co., 3737 W. Cortland St., Chicago 47, Ill.
Radioisotope Application Co., 1843 University Ave., Berkeley 3, Calif.
Scientific Service, Inc., 1417 Solano Ave., Albany, Calif.
Tenney Engineering, Inc., 26 Avenue B, Newark 5, N. J.

CABINETS—Instrument

Allied Radio Corp., 833 W. Jackson Blvd., Chicago 7, Ill.
Aloe Scientific Div. of A. S. Aloe Co., 5655 Kingsbury Blvd., St. Louis 12, Mo.
Bristol Metal Products Corp., Bristol, Tenn.
Brooklyn Hospital Equipment Co., Inc., 196 Lexington Ave., New York, N. Y.
COLE LTD., E. K., Electronics Div., Malmesbury, Wiltshire, England. ADV. PG. 28
Cutler Metal Products Co., Camden, N. J.
Durlach Can & Iron Works, 168 7th, Brooklyn, N. Y.
Emerson-Sack-Warner Corp., 150 Dorchester Ave., South Boston 23, Mass.
Falstrom Co., 7 Falstrom Court, Passaic, N. J.
Foxboro Co., 38 Neponset Ave., Foxboro, Mass.
Imhof, Ltd., Alfred, 112 New Oxford St., London, W. C. 1.
Insuline Corp. of America, 36–02 35th Ave., Long Island City, N. Y.
K-V Transformer Corp., 20 E. Franklin St., Danbury, Conn.
Leland Instruments Ltd., 22–23 Millbank, London, S. W. 1, England
Lyon Metal Products, Inc., 10 Montgomery St., Aurora, Ill.
Measurement Engineering Ltd., Arnprior, Ontario, Canada
Metalab Equipment Corp., 270 Duffy Ave., Hicksville, N. Y.
Pabst Engineering Equipment Co., Inc., Elizabeth, N. J.
Phoenix Precision Instrument Co., 3803–05 North 5th St., Philadelphia, Pa.
Radioisotope Application Co., 1843 University Ave., Berkeley 3, Calif.
Scientific Service, Inc., 1417 Solano Ave., Albany, Calif.
Taco West Corp., 525 N. Noble St., Chicago 22, Ill.
Tenney Engineering, Inc., 26 Avenue B, Newark 5, N. J.
Whittington Pump & Engineering Corp., 1126 Prospect St., Indianapolis 3, Ind.

CABINETS—Laboratory

Aloe Scientific Div. of A. S. Aloe Co., 5655 Kingsbury Blvd., St. Louis 12, Mo.
BAR-RAY PRODUCTS, INC., 209 25th St., Brooklyn 32, N. Y. ADV. PG. 112
BLICKMAN, INC., S., 7900 Gregory Ave., Weehawken, N. J. ADV. PG. 30
Bristol Metal Products Corp., Bristol, Tenn.
Brooklyn Hospital Equipment Co., Inc., 196 Lexington Ave., New York, N. Y.
Custom Scientific Instruments, Inc., P. O. Box 170, Arlington, N. J.
Cutler Metal Products Co., Camden, N. J.
Daylight Vacuum Products Co., 5207 N. Milwaukee Ave., Chicago 30, Ill.
Durlach Con & Iron Works, 168 7th, Brooklyn, N. Y.
Elmer & Amend Div. of Fisher Scientific Co., 635 Greenwich St., New York, N. Y.
Emerson-Sack-Warner Corp., 150 Dorchester Ave., South Boston 23, Mass.
Hamilton Mfg. Co., Two Rivers, Wis.
Insuline Corp. of America, 36-02 35th Ave., Long Island City, N. Y.
Kewaunee Mfg. Co., 5083 S. Center St., Adrian, Mich.
Laboratory Furniture Co., Inc., P. O. Box 590 Mineola, N. Y.
Lyon Metal Products, Inc., 10 Montgomery St., Aurora, Ill.
Measurement Engineering Ltd., Arnprior, Ontario, Canada
Metalab Equipment Corp., 270 Duffy Ave., Hicksville, N. Y.
Pabst Engineering Equipment Co., Inc., Elizabeth, N. J.
Phipps & Bird, Inc., 303 S. 6th St., Richmond 5, Va.
Precision Scientific Co., 3737 W. Cortland St., Chicago 47, Ill.
Radioisotope Application Co., 1843 University Ave., Berkeley 3, Calif.
Scientific Service, Inc., 1417 Solano Ave., Albany, Calif.
Tannay Engineering, Inc., 26 Avenue B, Newark 5, N. J.

CABINETS—Shielded

Aloe Scientific Div. of A. S. Aloe Co., 5655 Kingsbury Blvd., St. Louis 12, Mo.
BAR-RAY PRODUCTS, INC., 209 25th St., Brooklyn 32, N. Y. ADV. PG. 112
BLICKMAN, INC., S., 7900 Gregory Ave., Weehawken, N. J. ADV. PG. 30
Bohn Wood Products Co., Route 30 E, Fort Wayne, Ind.
Cutler Metal Products Co., Camden, N. J.
Durlach Con & Iron Works, 168 7th, Brooklyn, N. Y.
Emerson-Sack-Warner Corp., 150 Dorchester Ave., South Boston 23, Mass.
Kewaunee Mfg. Co., 5083 S. Center St., Adrian, Mich.
Langevin Mfg. Corp., 37 W. 65th St., New York 23, N. Y.
Measurement Engineering Ltd., Arnprior, Ontario, Canada
NUCLEAR INSTRUMENT & CHEMICAL CORP., 223 W. Erie St., Chicago 10, Ill. ADV. PG. Back Cover
Radiation Counter Labs., Inc., 1844 W. 21st St., Chicago 8, Ill.
Radioisotope Application Co., 1843 University Ave., Berkeley 3, Calif.
Radium Chemical Co., 161 E. 42nd St., New York 17, N. Y.
Scientific Service, Inc., 1417 Solano Ave., Albany, Calif.

CAGES—Animal

Aloe Scientific Div. of A. S. Aloe Co., 5655 Kingsbury Blvd., St. Louis 12, Mo.
BLICKMAN, INC., S., 7900 Gregory Ave., Weehawken, N. J. ADV. PG. 30
Bristol Metal Products Corp., Bristol, Tenn.
Cutler Metal Products Co., Camden, N. J.
Fischer-Nelson Corp., 617 N. 2nd St., Milwaukee 3, Wis.
Harford Metal Products, Inc., P. O. Box 459, Aberdeen, Md.
Yonkers Laboratory Supply Co., 70 Palisade Ave., Yonkers 2, N. Y.

CALORIMETERS

Jarrell-Ash Co., 165 Newberry St., Boston 16, Mass.
Kahl Scientific Instrument Corp., Box 1166, El Cajon, Calif.
National Appliance Co., Swan Island, Portland 18, Ore.
Parr Instrument Co., Moline, Ill.
Precision Scientific Co., 3737 W. Cortland St., Chicago 47, Ill.
Sargent & Co., E. H., 4647 W. Foster Ave., Chicago 30, Ill.
Welch Scientific Co., W. M., 1515 Sedgwick St., Chicago 10, Ill.

CAMERAS—Recording

Airmec Laboratories, Ltd., High Wycombe, Buckinghamshire, England
Austin Co., Special Devices Div., 76 Ninth Ave., New York 11, N. Y.
Berndt-Bach, Inc., 7377 Beverly Blvd., Los Angeles 36, Calif.
BURKE & JAMES, INC., 321 S. Wabash Ave., Chicago 4, Ill. ADV. PG. 133
DuMont Labs., Inc., Allen B., 1000 Main Ave., Clifton, N. J.
Fairchild Camera & Instrument Corp., 88-06 Van Wyck Blvd., Jamaica 1, N. Y.
Jarrell-Ash Co., 165 Newberry St., Boston 16, Mass.
LEITZ, INC., E., 304 Hudson St. at Spring St., New York 13, N. Y. ADV. PG. 121
Maurer, Inc., J. A., 37-01 31st St., Long Island City, N. Y.
PRAKTICA CO., INC., THE, 48 W. 29th St., New York 1, N. Y. ADV. PG. 122
Southwestern Industrial Electronics Co., 2831 Post Oak Rd., P. O. Box 13058, Houston 19, Texas
Vectron, Inc., 400 Main St., Waltham 54, Mass.

CAMERAS—Television

Douglas Radio Labs., 176 Norfolk Ave., Boston 19, Mass.
DuMont Labs., Inc., Allen B., Instrument Div., 1000 Main Ave., Clifton, N. J.
Electric & Musical Industries Ltd., Hayes, Middlesex, England
General Precision Laboratory, Inc., Pleasantville, N. Y.
Telechrome, Inc., 88 Merrick Road, Amityville, N. Y.
RADIO CORP. OF AMERICA, RCA VICTOR DIV., ENGINEERING PRODUCTS DEPT., Front & Cooper Sts., Camden, N. J. ADV. PG. 13

CAMERAS—X-RAY

CENTRAL RESEARCH LABORATORIES, INC., Red Wing, Minn. ADV. PG. 118
Fairchild Camera & Instrument Corp., 88-06 Van Wyck Blvd., Jamaica 1, N. Y.
Jarrell-Ash Co., 165 Newberry St., Boston 16, Mass.
North American Philips Co., Inc., 100 E. 42nd St., New York 17, N. Y.
Picker X-Ray Corp., 25 S. Broadway, White Plains, N. Y.
St. John X-Ray Laboratory, Califon, N. J.
X-Ray Department of General Electric Co., 4855 Electric Ave., Milwaukee 1, Wis.

CAPACITORS

NOTE: Various types of capacitors are not indicated in this listing. Contact manufacturer for specific type (s) desired.

Aerovox Corp., 740 Belleville Ave., New Bedford, Mass.
Aircraft-Marine Products, Inc., 2100 Paxton St., Harrisburg, Pa.
Amperex Electronic Corp., 230 Duffy Ave., Hicksville, N. Y.
Asheville Schoonmaker Mica Co., Inc., 62 Worth St., New York 13, N. Y.
Astron Corp., 225 Grant Ave., East Newark, N. J.
Bud Radio, Inc., 2118 E. 55th St., Cleveland 3, Ohio
Centralab Division of Globe-Union, Inc., 900 E. Keefe Ave., Milwaukee 1, Wis.
Condenser Products Co., 7517 N. Clark St., Chicago 26, Ill.
Cornell-Dubilier Electric Corp., South Plainfield, N. J.
Dumont Electric Corp., 308 Dyckman St., New York, N. Y.
Electro Motive Mfg. Co., Willimantic, Conn.
Erie Resistor Corp., 644 W. 12th St., Erie, Pa.
GENERAL ELECTRIC CO., Apparatus Sales Div., Schenectady 5, N. Y. ADV. PGS. 2-5
HAMMARLUND MFG. CO., 460 W. 34th St., New York 1, N. Y. ADV. PG. 113
Hi-Q Division, Aerovox Corp., Seneca Ave., Olean, N. Y.
Industrial Condenser Corp., 3243 N. California Ave., Chicago 18, Ill.
Jeffers Electronics Co., DuBois, Pa.
Jennings Radio Mfg. Co., 970 McLaughlin Ave., P. O. Box 1278, San Jose 12, Calif.
Johnson Co., E. F., Waseca, Minn.
Mallory & Co., Inc., P. R., 3029 E. Washington St., Indianapolis 6, Ind.
Plastic Capacitors, Inc., 2511 W. Moffat St., Chicago 47, Ill.
Pyramid Electric Co., 1445 Hudson Blvd., North Bergen, N. J.
ROCKBAR CORP., 211 E. 37th St., New York 16, N. Y. ADV. PG. 129
Sangamo Electric Co., Springfield, Ill.
Sprague Electric Co., North Adams, Mass.
STUPAKOFF CERAMIC & MFG. CO., Latrobe, Pa. ADV. PG. 131
Westinghouse Electric Corp., P. O. Box 868, Pittsburgh 30, Pa.

CARBOYS—Glass

Corning Glass Works, Corning, N. Y.

CARBOYS—Stoneware

Knight, Maurice A., 171 Kelly Ave., Akron, Ohio
U. S. Stoneware Co., Akron 9, Ohio

CATHETOMETERS

Eberbach Corporation, Ann Arbor, Mich.
Ferner Co., R. Y., 110 Pleasant St., Malden, Mass.
Gaertner Scientific Corp., 1237 Wrightwood Ave., Chicago, Ill.
Jarrell-Ash Co., 165 Newberry St., Boston 16, Mass.
Welch Scientific Co., W. M., 1515 Sedgwick St., Chicago 10, Ill.

CEMENTS—Acid Proof

AMERICAN PHENOLIC CORP., 1830 S. 54th Ave., Chicago 50, Ill. ADV. PG. 100
Atlas Mineral Products Co., 131 Norman St., Mertztown, Pa.
Biggs Co., Carl H., 11616 W. Pico Blvd., Los Angeles, Calif.
Carbolino Co., 7603 Forsythe Blvd., St. Louis 5, Mo.
Central Scientific Co., 1700 Irving Park Rd., Chicago 13, Ill.
Electro Chemical Supply & Engineering Co., 750 Broad St., Emmaus, Pa.
Industrial Tape Corp., Highway 25, New Brunswick, N. J.
Knight, Maurice A., 171 Kelly Ave., Akron, Ohio
Linick Chemical Co., 59 E. Madison St., Chicago 3, Ill.
Minnesota Mining & Mfg. Co., St. Paul 6, Minn.
Philadelphia Quartz Co., 1146 Public Ledger Bldg., Philadelphia 6, Pa.
Sauereisen Cements Co., Sauereisen Bldg., Pittsburgh 15, Pa.
Union Bay State Chemical Co., Cambridge, Mass.
U. S. GASKET CO., 602 N. 10th St., Camden, N. J. ADV. PG. 135
U. S. Stoneware Co., Akron 9, Ohio
Varnitan Co., 416 N. Varney St., Burbank, Calif.

CENTRIFUGES—Clinical

Aloe Scientific Div. of A. S. Aloe Co., 5655 Kingsbury Blvd., St. Louis 12, Mo.
Custom Scientific Instruments, Inc., P. O. Box 170, Arlington, N. J.
Fisher Scientific Co., 709 Forbes St., Pittsburgh 19, Pa.
International Equipment Co., 1284 Soldiers Field Rd., Boston 35, Mass.
Phillips-Drucker, 2245 S. Vandeventer Ave., St. Louis, Mo.
Precision Scientific Co., 3737 W. Cortland St., Chicago 47, Ill.
Yonkers Laboratory Supply Co., 70 Palisade Ave., Yonkers 2, N. Y.

CENTRIFUGES—Hand Operated

Bookel & Co., Inc., Wm., 309-319 Vine St., Philadelphia 6, Pa.
Precision Scientific Co., 3737 W. Cortland St., Chicago 47, Ill.

CENTRIFUGES—Micro

International Equipment Co., 1284 Soldiers Field Rd., Boston 35, Mass.
Phillips-Drucker, 2245 S. Vandeventer Ave., St. Louis, Mo.
Phipps & Bird, Inc., 303 S. 6th St., Richmond 5, Va.
Sargent & Co., E. H., 4647 W. Foster Ave., Chicago 30, Ill.
Yonkers Laboratory Supply Co., 70 Palisade Ave., Yonkers 2 N. Y.

CENTRIFUGES—Ultra

Aloe Scientific Div. of A. S. Aloe Co., 5655 Kingsbury Blvd., St. Louis 12, Mo.
Fisher Scientific Co., 709 Forbes St., Pittsburgh 19, Pa.
Specialized Instruments Corp., Belmont, Calif.

CERAMICS

Acme Brick Co., P. O. Box 425, Fort Worth 2, Texas
AMERICAN LAVA CORP., Chattanooga 5, Tenn. ADV. PG. 26
Centralab Division of Globe Union, Inc., 900 E. Keefe Ave., Milwaukee 1, Wis.
Coors Porcelain Co., Golden, Colo.
du Pont de Nemours & Co., Inc., E. I., Wilmington 98, Del.
Erie Resistor Corp., 644 W. 12th St., Erie, Pa.

General Ceramics & Steatite Corp., 250 Crows Mill Rd., Keasbey, N. J.
Glenco Corp., Metuchen, N. J.
Gulton Mfg. Corp., 212 Durham Ave., Metuchen, N. J.
Hermetic Seal Products Co., 29–37 S. 6th St., Newark 7, N. J.
Hommel Co., O., 209–213 Fourth Ave., Pittsburgh, Pa.
HORIZONS, INC., 2891 E. 79th St., Cleveland, Ohio. ADV. PG. 127
Knight, Maurice A., 171 Kelly Ave., Akron, Ohio
Lapp Insulator Co., Inc., 31 Gilbert St., LeRoy, N. Y.
Louthan Mfg. Co., East Liverpool, Ohio
Mallory & Co., Inc., P. R., 3029 E. Washington St., Indianapolis 6, Ind.
Porcelain Products, Inc., 422 W. Sandusky St., Findlay, Ohio
Star Porcelain Co., 61 Muirhead Ave., Trenton 9, N. J.
STUPAKOFF CERAMIC & MFG. CO., Latrobe, Pa. ADV. PG. 131
U. S. Stoneware Co., Akron 9, Ohio
Western Gold & Platinum Works, 589 Bryant St., San Francisco, Calif.

CHAMBERS—Ionization

ANTON ELECTRONIC LABS., INC., 1226–38 Flushing Ave., Brooklyn, N. Y. ADV. PG. 136
Applied Physics Corp., 362 W. Colorado St., Pasadena 1, Calif.
ATOMIC INSTRUMENT CO., 84 Massachusetts Ave., Cambridge 39, Mass. ADV. PG. 23
Atomlab, Inc., 489 Fifth Ave., New York 17, N. Y.
Baldwin Instrument Co., Ltd., Brooklands Works, Dartford, Kent, England
BAR-RAY PRODUCTS, INC., 209 25th St., Brooklyn 32, N. Y. ADV. PG. 112
COLE, LTD., E. K., Electronics Div., Malmesbury, Wiltshire, England. ADV. PG. 28
Dallons Labs., 5066 Santa Monica Blvd., Los Angeles, Calif.
Detectron Co., 5631 Cahuenga Blvd., North Hollywood, Calif.
El-Tronics, Inc., 2649 N. Howard St., Philadelphia 33, Pa.
Faik & Co., Ltd., M., 5 Victoria St., London, S. W. 1, England
GENERAL ELECTRIC CO., Apparatus Sales Div., Schenectady 5, N. Y. ADV. PGS. 2–5
Georator Corp., 1820 N. Nash St., Arlington, Va.
ISOTOPE SPECIALTIES CO., 3816 San Fernando Rd., Glendale, Calif. ADV. PG. 94
Landsverk Electrometer Co., 550–552 W. Garfield Ave., Glendale 4, Calif.
NUCLEAR INSTRUMENT & CHEMICAL CORP., 223 W. Erie St., Chicago 10, Ill. ADV. PG. Back Cover
Radiation Counter Labs., Inc., 1844 W. 21st St., Chicago 8, Ill.
Radioisotope Application Co., 1843 University Ave., Berkeley 3, Calif.
Resdel Engineering, 2351 Riverside Drive, Los Angeles 39, Calif.
Scientific Service Inc., 1417 Solano Ave., Albany, Calif.
TECHNICAL ASSOCIATES, INC., 140 W. Providencia Ave., Burbank, Calif. ADV. PG. 130
Twentieth Century Electronics, Ltd., Dunbar Works, Dunbar St., West Norwood, London, S. E. 27, England
VICTOREEN INSTRUMENT CO., 3800 Perkins Ave., Cleveland 14, Ohio. ADV. PG. Inside Front Cover
Western Radiation Lab., 1107 W. 24th St., Los Angeles 27, Calif.

CHAMBERS—Ionization, High Pressure

ANTON ELECTRONIC LABS., INC., 1226–38 Flushing Ave., Brooklyn 37, N. Y. ADV. PG. 136
Detectron Co., 5631 Cahuenga Blvd., North Hollywood, Calif.
El-Tronics, Inc., 2649 N. Howard St., Philadelphia 33, Pa.
GENERAL ELECTRIC CO., Apparatus Sales Div., Schenectady 5, N. Y. ADV. PGS. 2–5
Georator Corp., 1820 N. Nash St., Arlington, Va.
Nuclear Development Laboratory, P. O. Box 7034, Kansas City, Mo.
TECHNICAL ASSOCIATES, INC., 140 W. Providencia Ave., Burbank, Calif. ADV. PG. 130
VICTOREEN INSTRUMENT CO., 3800 Perkins Ave., Cleveland 14, Ohio. ADV. PG. Inside Front Cover

CHAMBERS—Test

American Instrument Co., Inc., 8030 Georgia Ave., Silver Spring, Md.
Bowser Technical Refrigeration Div., Bowser Inc., Terryville, Conn.
Landsverk Electrometer Co., 550–552 W. Garfield Ave., Glendale 4, Calif.
Northern-Zaleski, Ltd., Pratt Oval, Glen Cove, N. Y.
Tenney Engineering Inc., 26 Avenue B, Newark 5, N. J.
UNITED STATES TESTING CO., Hoboken, N. J. ADV. PG. 114
Whittington Pump & Engineering Corp., 1126 Prospect St., Indianapolis 3, Ind.
York Corp., York, Pa.

CHARGERS—Battery

Airpax Products Co., Middle River, Baltimore 20, Md.
Allied Radio Corp., 833 W. Jackson Blvd., Chicago 7, Ill.
American Television & Radio Co., 300 E. Fourth St., St. Paul 1, Minn.
Bogue Electric Mfg. Co., 52 Iowa Ave., Paterson 3, N. J.
Bogue Railway Equipment Div. of Bogue Electric Mfg. Co., 52 Iowa Ave., Paterson 3, N. J.
Electric Products Co., 1725 Clarkstone Rd., Cleveland 12, Ohio
Electro Products Labs., Inc., 4501 N. Ravenswood, Chicago 6, Ill.
Electronic Instrument Co., Inc., 276 Newport St., Brooklyn 12, N. Y.
Epco Products, Inc., 2500 Atlantic Ave., Brooklyn 7, N. Y.
Federal Telephone & Radio Corp., 100 Kingsland Rd., Clifton, N. J.
Georator Corp., 1820 N. Nash St., Arlington, Va.
Inet, Inc., 8655 S. Main St., Los Angeles 3, Calif.
Kato Engineering Co., 1415 First Ave., Mankato, Minn.
Kellogg Switchboard & Supply Co., 79 W. Monroe, Chicago 3, Ill.
KEPCO LABS., INC., 131–38 Sanford Ave., Flushing, N. Y. ADV. PGS. 10, 11
Mallory & Co., Inc., P. R., 3029 E. Washington St., Indianapolis 6, Ind.
Measurement Engineering Ltd., Arnprior, Ontario, Canada
Mellaphone Corporation, Rochester 2, N. Y.
Phoenix Precision Instrument Co., 3803–05 N. 5th St., Philadelphia, Pa.
Raytheon Mfg. Corp., Equipment Sales Div., Waltham 54, Mass.
SORENSEN & CO., INC., 375 Fairfield Ave., Stamford, Conn. ADV. PG. 125
Sun Electric Corp., 6323 Avondale Ave., Chicago 31, Ill.
T. L. G. Electric Corp., 31 W. 27th St., New York 1, N. Y.
Ther Electric & Machine Works, 15 S. Jefferson St., Chicago 6, Ill.
Vickers Electric Division, Vickers, Inc., 1815 Locust St., St. Louis, Mo.
VICTOREEN INSTRUMENT CO., 3800 Perkins Ave., Cleveland 14, Ohio. ADV. PG. Inside Front Cover
Westinghouse Electric Corp., P. O. Box 868, Pittsburgh 30, Pa.

CHARGERS—Dosimeter

Baldwin Instrument Co., Ltd., Brooklands Works, Dartford, Kent, England
Beckman, Inc., Arnold O., 1020 Mission St., South Pasadena, Calif.
CAMBRIDGE INSTRUMENT CO., INC., 3786 Grand Central Terminal, New York 17, N. Y. ADV. PG. 123
GENERAL ELECTRIC CO., Apparatus Sales Dept., Schenectady 5, N. Y. ADV. PGS. 2–5
Landsverk Electrometer Co., 550–552 W. Garfield Ave., Glendale 4, Calif.
NUCLEAR INSTRUMENT & CHEMICAL CORP., 223 W. Erie St., Chicago 10, Ill. ADV. PG. Back Cover
NUCLEAR RESEARCH CORP., 2563 Grays Ferry Ave., Philadelphia 46, Pa. ADV. PG. 97
Radiation Counter Labs., Inc., 1844 W. 21st St., Chicago 8, Ill.
TRACERLAB, INC., 130 High St., Boston 10, Mass. ADV. PG. 24
VICTOREEN INSTRUMENT CO., 3800 Perkins Ave., Cleveland 14, Ohio. ADV. PG. Inside Front Cover

CHEMICALS—Inorganic

Allied Chemical & Dye Corp., Solvay Process Div., 61 Broadway, New York 6, N. Y.
Alse Scientific Div. of A. S. Alse Co., 5655 Kingsbury Blvd., St. Louis 12, Mo.
Aluminum Co. of America, 801 Gulf Bldg., Pittsburgh, Pa.
American Cyanamid Co., 30 Rockefeller Plaza, New York 20, N. Y.
Baker Chemical Co., J. T., Phillipsburg, N. J.
du Pont de Nemours & Co., Inc., E. I., Wilmington 98, Del.
Fisher Scientific Co., 709 Forbes St., Pittsburgh 19, Pa.
General Dyestuff Corp., 435 Hudson St., New York 14, N. Y.
Humboldt Mfg. Co., 2814 N. Whipple St., Chicago 47, Ill.
Jasonels Chemical Corp., 1085 Myrtle Ave., Brooklyn 6, N. Y.
Linick Chemical Co., 59 E. Madison St., Chicago 3, Ill.
Mallinckrodt Chemical Works, Second & Mallinckrodt Sts., St. Louis 7, Mo.
Mathieson Chemical Corp., Mathieson Bldg., Baltimore 3, Md.
Merck & Co., Inc., Rahway, N. J.
Monsanto Chemical Co., 1700 S. Second St., St. Louis 4, Mo.
NUCLEAR INSTRUMENT & CHEMICAL CORP., 223 W. Erie St., Chicago 10, Ill. ADV. PG. Back Cover
NUCLEAR RESEARCH CORP., 2563 Grays Ferry Ave., Philadelphia 46, Pa. ADV. PG. 97
Philadelphia Quartz Co., 1146 Public Ledger Bldg., Philadelphia 6, Pa.
Reichhold Chemicals, Inc., 630 Fifth Ave., New York 20, N. Y.
Sylvania Electric Products, Inc., 1740 Broadway, New York 19, N. Y.
Will Corp., Rochester 3, N. Y.
Yonkers Laboratory Supply Co., 70 Palisade Ave., Yonkers 2, N. Y.

CHEMICALS—Organic

Allied Chemical & Dye Corp., Solvay Process Div., 61 Broadway, New York 6, N. Y.
Alse Scientific Div. of A. S. Alse Co., 5655 Kingsbury Blvd., St. Louis 12, Mo.
American Cyanamid Co., 30 Rockefeller Plaza, New York 20, N. Y.
Baker Chemical Co., J. T., Phillipsburg N. J.
BERSWORTH CHEMICAL CO., 875 Waverly St., Framingham, Mass. ADV. PG. 129
Carbide & Chemicals Co., Div. Union Carbide & Carbon Corp., 30 E. 42nd St., New York 17, N. Y.
Celanese Chemical Corp., 180 Madison Ave., New York 16, N. Y.
Commercial Solvents Corp., 260 Madison Ave., New York 16, N. Y.
DISTILLATION PRODUCTS INDUSTRIES, A Division of Eastman Kodak Co., Rochester 3, N. Y. ADV. PG. 91
du Pont de Nemours & Co., Inc., E. I., Wilmington 98, Del.
Fisher Scientific Co., 709 Forbes St., Pittsburgh 19, Pa.
General Biochemicals Inc., Laboratory Park, Chagrin Falls, Ohio
General Dyestuff Corp., 435 Hudson St., New York 14, N. Y.
Hommel Co., O., 209–213 Fourth Ave., Pittsburgh, Pa.
Jasonels Chemical Corp., 1085 Myrtle Ave., Brooklyn 6, N. Y.
Kessler Chemical Co., Inc., State Rd. & Cottman Ave., Philadelphia 35, Pa.
Mallinckrodt Chemical Works, Second & Mallinckrodt Sts., St. Louis 7, Mo.
Mathieson Chemical Corp., Mathieson Bldg., Baltimore 3, Md.
Merck & Co., Inc., Rahway, N. J.
Minnesota Mining & Mfg. Co., St. Paul 6, Minn.
Monsanto Chemical Co., 1700 S. Second St., St. Louis 4, Mo.
NUCLEAR INSTRUMENT & CHEMICAL CORP., 223 W. Erie St., Chicago 10, Ill. ADV. PG. Back Cover
NUCLEAR RESEARCH CORP., 2563 Grays Ferry Ave., Philadelphia 46, Pa. ADV. PG. 97
Reichhold Chemicals, Inc., 630 Fifth Ave., New York 20, N. Y.
Will Corp., Rochester 3, N. Y.
Yonkers Laboratory Supply Co., 70 Palisade Ave., Yonkers 2, N. Y.

CHRONOGRAPHS

Associated Research, Inc., 3788 W. Belmont, Chicago, Ill.
Austin Co., Special Devices Div., 76 Ninth Ave., New York 11, N. Y.
CAMBRIDGE INSTRUMENT CO., INC., 3786 Grand Central Terminal, New York 17, N. Y. ADV. PG. 123
Cinema-Television Ltd., Worsley Bridge Rd., London S. E. 26, England
Electro Medical Lab., Inc., South Woodstock 6, Vt.
Electrodyne Co., 32 Oliver St., Boston, Mass.
El-Tronics, Inc., 2649 N. Howard St., Philadelphia 33, Pa.
Gaertner Scientific Corp., 1237 Wrightwood Ave., Chicago, Ill.
Garrell & Garrell, Haworth, N. J.
Measurement Engineering Ltd., Arnprior, Ontario, Canada
Potter Instrument Co., 115 Cutter Mill Rd., Great Neck, N. Y.
Sticht, Inc., Herman H., 27 Park Place, New York 7, N. Y.
Vectron, Inc., 400 Main St., Waltham 54, Mass.

CHRONOSCOPES

American Chronoscope Corp., 316 W. First St., Mt. Vernon, N. Y.
Cinema-Television Ltd., Worsley Bridge Rd., London, S. E. 26, England
Rutherford Electronics Corp., 3707 S. Robertson Blvd., Culver City, Calif.

Standard Electric Time Co., 89 Logan St., Springfield, Mass.
Stichi, Inc., Herman H., 27 Park Place, New York 7, N. Y.

CLAMPS

Boekel & Co., Inc., Wm., 509–519 Vine St., Philadelphia 6, Pa.
Chandler & Stadman, 398 Newton St., Waltham 54, Mass.
Elmer & Amend Div. of Fisher Scientific Co., 635 Greenwich St., New York, N. Y.
Falstrom Co., 7 Falstrom Court, Passaic, N. J.
Fisher Scientific Co., 709 Forbes St., Pittsburgh 19, Pa.
Gaertner Scientific Corp., 1237 Wrightwood Ave., Chicago, Ill.
Humboldt Mfg. Co., 2814 N. Whipple St., Chicago 47, Ill.
Millen Mfg. Co., James, 150 Exchange St., Malden, Mass.
Phipps & Bird, Inc., 303 S. 6th St., Richmond 5, Va.
Precision Scientific Co., 3737 W. Cortland St., Chicago 47, Ill.
Sargent & Co., E. H., 4647 W. Foster Ave., Chicago 30, Ill.
South River Metal Products Co., Inc., 377–379 Turnpike, South River, N. J.
York Clock Co., Inc., Mount Vernon, N. Y.
Unistrut Products Co., 1013 W. Washington St., Chicago 7, Ill.
Yonkers Laboratory Supply Co., 70 Palisade Ave., Yonkers 2, N. Y.

CLEANERS—Bottle

Allied Chemical & Dye Corp., Solvay Process Div., 61 Broadway, New York 6, N. Y.
Linick Chemical Co., 59 E. Madison St., Chicago 3, Ill.
Philadelphia Quartz Co., 1146 Public Ledger Bldg., Philadelphia 6, Pa.

CLEANERS—Vacuum

American Vacuum Co., 816 S. Michigan Ave., Chicago, Ill.
Brauer Electric Mfg. Co., 5100 N. Ravenswood Ave., Chicago 40, Ill.
Colloid Equipment Co., Inc., 50 Church St., New York 7, N. Y.
Martindale Electric Co., 1375 Hird Ave., Cleveland 7, Ohio
Whittington Pump & Engineering Corp., 1126 Prospect St., Indianapolis 3, Ind.

CLEANING REAGENTS

Alox Scientific Div. of A. S. Alox Co., 5655 Kingsbury Blvd., St. Louis 12, Mo.
BERSWORTH CHEMICAL CO., 675 Waverly St., Framingham, Mass. ADV. PG. 129
General Dyestuff Corp., 435 Hudson St., New York 14, N. Y.
Jaconais Chemical Corp., 1085 Myrtle Ave., Brooklyn 6, N. Y.
Linick Chemical Co., 59 E. Madison St., Chicago 3, Ill.
Monsanto Chemical Co., 1700 S. Second St., St. Louis 4, Mo.
Philadelphia Quartz Co., 1146 Public Ledger Bldg., Philadelphia 6, Pa.
Thomas Co., Arthur H., W. Washington Square, Philadelphia 5, Pa.

CLOTH—Acid & Alkali Resisting

Newark Wire Cloth Co., 351 Verona Ave., Newark 4, N. J.
Owens-Corning Fiberglas Corp., 16 E. 56th St., New York 22, N. Y.

CLOTHING—Acid Proof

American Optical Co., Southbridge, Mass.
Bullard Co., E. D., 275 Eighth St., San Francisco 3, Calif.
Goodrich Co., B. F., Akron, Ohio
MINE SAFETY APPLIANCES CO., 201 N. Braddock Ave., Pittsburgh 21, Pa. ADV. PG. 130
Owens-Corning Fiberglas Corp., 16 E. 56th St., New York 22, N. Y.
Sauereisen Cements Co., Sauereisen Bldg., Pittsburgh 15, Pa.
U. S. Rubber Co., 1230 Avenue of the Americas, New York 20, N. Y.

COATINGS—Conductive

Acheson Colloids Co., Div. of Acheson Industries, Inc., 1630 Washington Ave., Port Huron, Mich.
Atlas Mineral Products Co., 131 Norman St., Mertztown, Pa.
Biggs Co., Carl H., 11616 W. Pico Blvd., Los Angeles, Calif.
du Pont de Nemours & Co., Inc., E. I., Wilmington 98, Del.
Emerson & Cuming Co., 126 Massachusetts Ave., Boston, Mass.
General Cement Co., 919 Taylor Ave., Rockford, Ill.
Hommel Co., O., 209–213 Fourth Ave., Pittsburgh, Pa.
Interelectronics Corp., 2432 Grand Concourse, New York 58, N. Y.
Linick Chemical Co., 59 E. Madison St., Chicago 3, Ill.
Micro-Circuits Co., New Buffalo, Mich.
OPTICAL FILM ENGINEERING CO., 2731–37 N. 6th St., Philadelphia 33, Pa. ADV. PG. 106
Sauereisen Cements Co., Sauereisen Bldg., Pittsburgh 15, Pa.
Sylvania Electric Products, Inc., 1740 Broadway, New York 19, N. Y.

COATINGS—Protective

American Pipe & Construction Co., Amercoat Div., Los Angeles 54, Calif.
American Resinous Chemicals Corp., 103 Foster St., Peabody, Mass.
Arco Co., The, 7301 Bessemer Ave., Cleveland 27, Ohio
Armstrong Cork Co., 1010 Concord St., Lancaster, Pa.
Atlas Mineral Products Co., 131 Norman St., Mertztown, Pa.
Biggs Co., Carl H., 11616 W. Pico Blvd., Los Angeles, Calif.
Bishop Mfg. Corp., 10 Canfield Rd., Cedar Grove, N. J.
Carboline Co., 7603 Forsythe Blvd., St. Louis 5, Mo.
Cooper Co., D. C., 1467 S. Michigan Ave., Chicago, Ill.
Devoe & Raynolds Co., Inc., 787 First Ave., New York, N. Y.
Division Lead Co., 836 W. Kinzie St., Chicago 22, Ill.
du Pont de Nemours & Co., Inc., E. I., Wilmington 98, Del.
Eagle-Picher Co., Cincinnati, Ohio
Electro-Technical Products Div., San Chemical Corp., 113 E. Centre St., Nutley 10, N. J.
General Cement Co., 919 Taylor Ave., Rockford, Ill.
Emerson & Cuming Co., 126 Massachusetts Ave., Boston, Mass.
Goodrich Co., B. F., 448 S. Main St., Akron, Ohio
Goodyear Tire & Rubber Co., Akron, Ohio
Hamilton Kent Mfg. Co., Kent, Ohio
Highside Chemicals Co., 10 Colfax Ave., Clifton, N. J.
Hommel Co., O., 209–213 Fourth Ave., Pittsburgh, Pa.
Horn Co., Inc., A. C., 10th St. & 44th Ave., Long Island City 1, N. Y.
Inertol Co., Inc., 480 Frelinghuysen Ave., Newark 5, N. J.
Interelectronics Corp., 2432 Grand Concourse, New York 58, N. Y.
Irvington Varnish & Insulator Co., 6 Argyle Terrace, Irvington, N. J.
Knight Maurice A., 171 Kelly Ave., Akron, Ohio
Koppers Co., Inc., Koppers Bldg., Pittsburgh, Pa.
Micro-Circuits Co., New Buffalo, Mich.
Mitchell-Rand Insulation Co., Inc., 51 Murray St., New York 7, N. Y.
Nukem Products Corp., 111 Colgate Ave., Buffalo 20, N. Y.
Owens Corning Fiberglas Corp., 16 E. 56th St., New York 22, N. Y.
Pabst Engineering Equipment Co., Inc., Elizabeth, N. J.
Philadelphia Quartz Co., 1146 Puublic Ledger Bldg., Philadelphia 6, Pa.
Polymer Industries Inc., 1108 30th Ave., Astoria N. Y.
Prufcoat Laboratories, Inc., 63 Main St., Cambridge 42, Mass.
Radioisotope Application Co., 1843 University Ave., Berkeley 3, Calif.
Reichhold Chemicals, Inc., 630 Fifth Ave., New York 20, N. Y.
Rubber & Plastics Compound Co., Inc., 30 Rockefeller Plaza, New York 20, N. Y.
Sauereisen Cements Co., Sauereisen Bldg., Pittsburgh 15, Pa.
Scientific Service, Inc., 1417 Solano Ave., Albany, Calif.
Shell Oil Co., 50 W. 50th St., New York, N. Y.
Union Bay State Chemical Co., Cambridge, Mass.
United Chromium, Inc., 100 East 42nd St., New York, N. Y.
U. S. Stoneware Co., Akron 9, Ohio
U. S. GASKET CO., 602 N. 10th St., Camden, N. J. ADV. PG. 135
U. S. Rubber Co., 1230 Avenue of the Americas, New York 20, N. Y.
Varnitan Co., 416 N. Varney St., Burbank, Calif.
Zophar Mills, Inc., 112–130 26th St., Brooklyn 32, N. Y.

COATINGS—Strippable

American Resinous Chemicals Corp., 103 Foster St., Peabody, Mass.
Armstrong Cork Co., 1010 Concord St., Lancaster, Pa.
Atlas Mineral Products Co., 131 Norman St., Mertztown, Pa.
Carboline Co., 7603 Forsythe Blvd., St. Louis 5, Mo.
Cooper Co., D. C., 1467 S. Michigan Ave., Chicago, Ill.
Emerson & Cuming Co., 126 Massachusetts Ave., Boston, Mass.
Irvington Varnish & Insulator Co., 10 Argyle Terrace, Irvington, N. J.
Polymer Industries Inc., 1108 30th Ave., Astoria, N. Y.
Radioisotope Application Co., 1843 University Ave., Berkeley, 3, Calif.
Scientific Service, Inc., 1417 Solano Ave., Albany, Calif.
United Chromium, Inc., 100 E. 42nd St., New York, N. Y.
U. S. Stoneware Co., Akron 9, Ohio
Varnitan Co., 416 N. Varney St., Burbank, Calif.
Zophar Mills, Inc., 112–130 26th St., Brooklyn 32, N. Y.

COLLECTORS—Dust

Aget-Detroit Co., 612 First National Bank Bldg., Ann Arbor, Mich.
American Air Filter Co., Inc., 215 Central Ave., Louisville 8, Ky.
American Vacuum Co., 816 S. Michigan Ave., Chicago, Ill.
Brauer Electric Mfg. Co., 5100 N. Ravenswood Ave., Chicago 40, Ill.
Day Co., The, 820 Third Ave., NE, Minneapolis 13, Minn.
Electrovent Fan & Mfg. Co., 812 W. Lake St., Chicago 7, Ill.
Falstrom Co., 7 Falstrom Court, Passaic, N. J.
Gulton Mfg. Corp., 212 Durham Ave., Metuchen, N. J.
Houston Blow Pipe & Sheet Metal Works, P. O. Box 1692, Houston 1, Texas
ISOTOPE SPECIALTIES CO., 3816 San Fernando Rd., Glendale, Calif. ADV. PG. 94
Koppers Co., Inc., Koppers Bldg., Pittsburgh, Pa.
MINE SAFETY APPLIANCES CO., 201 N. Braddock Ave., Pittsburgh 21, Pa. ADV. PG. 130
Northern Blower Co., 6427 Barberton Ave., Cleveland 2, Ohio
Pabst Engineering Equipment Co., Inc., Elizabeth, N. J.
Pulverizing Machinery Co., 43 Chatham Rd., Summit, N. J.
Sargent & Co., E. H., 4647 W. Foster Ave., Chicago 30, Ill.
Scientific Glass Apparatus Co., Inc., 100 Lakewood Terrace, Bloomfield, N. J.
THOMPSON CO., H. I., 1733 Cordova St., Los Angeles 7, Calif. ADV. PG. 120

COLORIMETERS

American Optical Co., Instrument Div., Buffalo 15, N. Y.
Baldwin Instrument Co., Ltd., Brooklands Works, Dartford, Kent, England
Bausch & Lomb Optical Co., 630 St. Paul St., Rochester 2, N. Y.
Beckman Instruments, Inc., 820 Mission St., South Pasadena 183, Calif.
Biddle Co., James G., 1316 Arch St., Philadelphia 7, Pa.
Brociner-Mass Instruments, Inc., 1546 Second Ave., New York 28, N. Y.
Central Scientific Co., 1700 Irving Park Rd., Chicago 13, Ill.
Coleman Instruments, Inc., Maywood, Ill.
Fisher Scientific Co., 709 Forbes St., Pittsburgh 19, Pa.
Hellige, Inc., 3718 Northern Blvd., Long Island City 1, N. Y.
Huggins Laboratories, 734 Hamilton Ave., Menlo Park, Calif.
LEITZ, INC., E., 304 Hudson St. at Spring St., New York 13, N. Y. ADV. PG. 121
Manufacturers Engineering & Equipment Corp., York & Mill Rds., Horsham, Pa.
Phoenix Precision Instrument Co., 3803–05 North 5th St., Philadelphia, Pa.
Photocon Research Products, 421 N. Foothill Blvd., Pasadena 7, Calif.
Photovolt Corp., 95 Madison Ave., New York 16, N. Y.
Rubicon Co., Ridge Ave. at 35th St., Philadelphia 32, Pa.
Sargent & Co., E. H., 4647 W. Foster Ave., Chicago 30, Ill.
Welch Scientific Co., W. M., 1515 Sedgwick St., Chicago 10, Ill.
Will Corp., Rochester 3, N. Y.
Yonkers Laboratory Supply Co., 70 Palisade Ave., Yonkers 2, N. Y.

COLUMNS—Absorption

Babcock & Wilcox Co., 161 E. 42nd St., New York 17, N. Y.
Daylight Vacuum Products Co., 5207 N. Milwaukee Ave., Chicago 30, Ill.
Fisher Scientific Co., 709 Forbes St., Pittsburgh 19, Pa.
Glass Engineering Laboratories, Belmont, Calif.
Hickey Inc., Fred S., 5041 W. Lake St., Chicago 44, Ill.
Knight, Maurice A., 171 Kelly Ave., Akron, Ohio
Leader Iron Works, Inc., 2110 N. Jasper, Decatur, Ill.
Pfaudler Co., 1002 West Ave., Rochester, N. Y.
Scientific Glass Apparatus Co., Inc., 100 Lakewood Terrace, Bloomfield, N. J.
Struthers-Wells Corp., Warren, Pa.
U. S. Stoneware Co., Akron 9, Ohio

COLUMNS—Distilling, Fractionating, etc.

American Copper & Brass Works, Inc., Cincinnati 2, Ohio
Babcock & Wilcox Co., 161 E. 42nd St., New York 17, N. Y.
Brighton Copper Works, Inc., 2146 Colerain Ave., Cincinnati, Ohio
Corning Glass Works, Corning, N. Y.
Daylight Vacuum Products Co., 5207 N. Milwaukee Ave., Chicago 30, Ill.
Fisher Scientific Co., 709 Forbes St., Pittsburgh 19, Pa.
General Mixing Equipment Co., 413 N. 3rd St., Philadelphia, Pa.
Glass Engineering Laboratories, Belmont, Calif.
Hickey Inc., Fred S., 5041 W. Lake St., Chicago 44, Ill.
Knight, Maurice A., 171 Kelly Ave., Akron, Ohio
Leader Iron Works, Inc., 2110 N. Jasper, Decatur, Ill.
Pfaudler Co., 1002 West Ave., Rochester, N. Y.
Radiation Counter Labs., Inc., 1844 W. 21st St., Chicago 8, Ill.
Sargent & Co., E. H., 4647 W. Foster Ave., Chicago 30, Ill.
Scientific Glass Apparatus Co., Inc., 100 Lakewood Terrace, Bloomfield, N. J.
Struthers-Wells Corp., Warren, Pa.
U. S. Stoneware Co., Akron 9, Ohio
Yonkers Laboratory Supply Co., 70 Palisade Ave., Yonkers 2, N. Y.

COLUMNS—Ion Exchange

Hickey Inc., Fred S., 5041 W. Lake St., Chicago 44, Ill.
Illinois Water Treatment Co., 858 Cedar St., Rockford, Ill.
Infilco, Inc., P. O. Box 5033, Tucson, Ariz.
KONTES GLASS CO., Spruce St., Vineland, N. J. ADV. PG. 126
Leader Iron Works, Inc., 2110 N. Jasper, Decatur, Ill.
Permutit Co., 330 W. 42nd St., New York 36, N. Y.
Radiation Counter Labs., Inc., 1844 W. 21st St., Chicago 8, Ill.
Radioisotope Application Co., 1843 University Ave., Berkeley 3, Calif.
Sargent & Co., E. H., 4647 W. Foster Ave., Chicago 30, Ill.
Scientific Glass Apparatus Co., Inc., 100 Lakewood Terrace, Bloomfield, N. J.
Scientific Service, Inc., 1417 Solano Ave., Albany, Calif.

COMPARATOR—DENSITOMETERS

Gaertner Scientific Corp., 1237 Wrightwood Ave., Chicago, Ill.
Jarrell-Ash Co., 165 Newberry St., Boston 16, Mass.
Leeds & Northrup Co., 4970 Stenton Ave., Philadelphia 44, Pa.
Standard Electronics Research Corp., 2 East End Ave., New York 21, N. Y.
Welch Scientific Corp., W. M., 1515 Sedgwick St., Chicago 10, Ill.

COMPARATORS—Hydrogen Ion

CAMBRIDGE INSTRUMENT CO., INC., 3786 Grand Central Terminal, New York 17, N. Y. ADV. PG. 123
Central Scientific Co., 1700 Irving Park Rd., Chicago 13, Ill.
LaMotte Chemical Products Co., Towson 4, Md.
Leeds & Northrup Co., 4970 Stenton Ave., Philadelphia 44, Pa.
Yonkers Laboratory Supply Co., 70 Palisade Ave., Yonkers 2, N. Y.

COMPARATORS—Micro Photometer

Farrand Optical Co., Inc., Bronx Blvd. at E. 238th St., New York 70, N. Y.
Gaertner Scientific Corp., 1237 Wrightwood Ave., Chicago, Ill.
Jarrell-Ash Co., 165 Newberry St., Boston 16, Mass.
Leeds & Northrup Co., 4970 Stenton Ave., Philadelphia 44, Pa.
Measurement Engineering Ltd., Arnprior, Ontario, Canada
Phoenix Precision Instrument Co., 3803-05 North 5th St., Philadelphia, Pa.
Welch Scientific Co., W. M., 1515 Sedgwick St., Chicago 10, Ill.

COMPRESSORS

Beach-Russ Co., 44 Church St., New York 7, N. Y.
Carrier Corp., 300 S. Geddes St., Syracuse 1, N. Y.
Clark Bros. Co., Inc., Lincoln Ave. & 15th St., Olean, N. Y.
Cooper Co., D. C., 1467 S. Michigan Ave., Chicago, Ill.
Dayton Electric Mfg. Co., 748 W. Adams, Chicago, Ill.
Decora Mfg. Co., Emeryville, Calif.
Jay Mfg. Co., Oliver Bldg., Pittsburgh 22, Pa.
Kahlenberg Bros. Co., 12th & Monroe Sts., Two Rivers, Wis.
Keystone Compressor Co., 8417 Hagerman St., Philadelphia 36, Pa.
Phillips-Drucker, 2245 S. Vandeventer Ave., St. Louis, Mo.
Rosdel Engineering, 2351 Riverside Drive, Los Angeles 39, Calif.
Worthington Corp., 426 Worthington Ave., Harrison, N. J.
York Corp., York, Pa.

COMPUTERS—Analog

American Electronic Laboratories, Inc., 641 Arch St., Philadelphia 6, Pa.
Arma Corp., 254 36th St., Brooklyn 32, N. Y.
ATOMIC INSTRUMENT CO., 84 Massachusetts Ave., Cambridge 39, Mass. ADV. PG. 23
Atomlab, Inc., 489 Fifth Ave., New York 17, N. Y.
Audio Instrument Co., 113 W. 14th St., New York 11, N. Y.
Avion Instrument Corp., Paramus, N. J.
Beckman Instruments, Inc., 820 Mission St., South Pasadena 183, Calif.
Computer Corp. of America, 149 Church St., New York, N. Y.
Consolidated Engineering Corp., 300 N. Sierra Madre Villa, Pasadena 8, Calif.
Davies Laboratories, Inc., 4705 Queensbury Rd., Riverdale, Md.
Electro-Mec Laboratory, 19 Murray St., New York 7, N. Y.
ELECTRONIC ASSOCIATES, INC., Long Branch, N. J. ADV. PG. 9
Ford Instrument Co., 31-10 Thomson Ave., Long Island City, N. Y.
GENERAL ELECTRIC CO., Apparatus Sales Div., Schenectady 5, N. Y. ADV. PGS. 2-5
General Magnetics, Inc., 135 Bloomfield Ave., Bloomfield, N. J.
Gerber Scientific Instrument Co., The, 89 Spruce St., Hartford, Conn.
Goodyear Aircraft Corp., Akron 15, Ohio
LABORATORY FOR ELECTRONICS INC., 43 Leon St., Boston 15, Mass. ADV. PG. 15
Leland Instruments Ltd., 22-23 Millbank, London, S. W. 1, England
Librascope, Inc., 1607 Flower St., Glendale 1, Calif.
Miller Corp., William, 325 N. Halstead Ave., Pasadena 8, Calif.
Minnesota Electronics Corp., 47 W. Water St., St. Paul 1, Minn.
North American Philips Co., Inc., 100 E. 42nd St., New York 17, N. Y.
Nuclear Specialty Co., P. O. Box 455, Center Moriches, N. Y.
Raytheon Mfg. Co., Equipment Sales Div., Waltham 54, Mass.
Reeves Instrument Corp., 215 E. 91st, New York 28, N. Y.
Rosdel Engineering, 2351 Riverside Drive, Los Angeles 39, Calif.
Servo Corp. of America, 2020 Jericho Turnpike, New Hyde Park, N. Y.
SERVOMECHANISMS, INC., Post & Stewart Aves., Westbury, N. Y. ADV. PG. 109
Streeter-Amet Co., 4101 Ravenswood Ave., Chicago 13, Ill.
Vectron, Inc., 400 Main St., Waltham 54, Mass.

COMPUTERS—Digital

Air Associates, Inc., Teterboro, N. J.
Applied Science Corp. of Princeton, P. O. Box 44, Princeton, N. J.
Arma Corp., 254 36th St., Brooklyn 32, N. Y.
ATOMIC INSTRUMENT CO., 84 Massachusetts Ave., Cambridge 39, Mass. ADV. PG. 23
Audio Instrument Co., 113 W. 14th St., New York 11, N. Y.
Avion Instrument Corp., Paramus, N. J.
Computer Research Corp., 3348 W. El Segundo Blvd., Hawthorne, Calif.
Consolidated Engineering Corp., 300 N. Sierra Madre Villa, Pasadena 8, Calif.
Electronic Computer Corp., 160 Avenue of the Americas, New York 13, N. Y.
Engineering Research Associates, Inc., 1902 W. Minnehaha Ave., St. Paul 4, Minn.
Ferranti Electric, Inc., 30 Rockefeller Plaza, New York 20, N. Y.
GENERAL ELECTRIC CO., Apparatus Sales Div., Schenectady 5, N. Y. ADV. PGS. 2-5
Hogan Laboratories, Inc., 155 Perry St., New York 14, N. Y.
Jacobs Instrument Co., 4718 Bethesda Ave., Bethesda, Md.
LABORATORY FOR ELECTRONICS, INC., 43 Leon St., Boston 15, Mass. ADV. PG. 15
Librascope, Inc., 1607 Flower St., Glendale 1, Calif.
Minnesota Electronics Corp., 47 W. Water St., St. Paul 1, Minn.
NUCLEAR DEVELOPMENT ASSOCIATES, INC., 80 Grand St., White Plains, N. Y. ADV. PG. 110
Potter Instrument Co., Inc., 115 Cutter Mill Rd., Great Neck, N. Y.
Raytheon Mfg. Co., Equipment Sales Div., Waltham 54, Mass.
Rosdel Engineering, 2351 Riverside Drive, Los Angeles 39, Calif.
Servo Corp. of America, 2020 Jericho Turnpike, New Hyde Park, N. Y.
TECHNITROL ENGINEERING CORP., 2751 N. 4th St., Philadelphia 33, Pa. ADV. PG. 132
Vectron, Inc., 400 Main St., Waltham 54, Mass.
Walkirt Co., 145 W. Hazel, Inglewood, Calif.
Wang Laboratories, 296 Columbus Ave., Boston 16, Mass.

COMPUTERS—Electronic

Acme Electronics, Inc., 300 N. Lake Ave., Pasadena 4, Calif.
Air Associates Inc., Teterboro, N. J.
American Electronic Laboratories, Inc., 641 Arch St., Philadelphia 6, Pa.
Applied Science Corp. of Princeton, P. O. Box 55, Princeton, N. J.
Arma Corp., 254 36th St., Brooklyn 32, N. Y.
ATOMIC INSTRUMENT CO., 84 Massachusetts Ave., Cambridge 39, Mass. ADV. PG. 23
Atomlab, Inc., 489 Fifth Ave., New York 17, N. Y.
Audio Instrument Co., 113 W. 14th St., New York 11, N. Y.
Avion Instrument Corp., Paramus, N. J.
Beckman Instruments, Inc., 820 Mission St., South Pasadena 183, Calif.
Bogue Electric Mfg. Co., 52 Iowa Ave., Paterson 3, N. J.
Collins Radio Co., Cedar Rapids, Iowa
Computer Corp. of America, 149 Church St., New York, N. Y.
Computer Research Corp., 3348 W. El Segundo Blvd., Hawthorne, Calif.
Consolidated Engineering Corp., 300 N. Sierra Madre Villa, Pasadena 8, Calif.
Cossor (Canada) Ltd., 301 Windsor St., Halifax, N. S., Canada
Davies Laboratories, Inc., 4705 Queensbury Rd., Riverdale, Md.
Detectron Co., 5631 Cahuenga Blvd., North Hollywood, Calif.
Electro-Mechanical Research, Inc., 64 Main St., Ridgefield, Conn.
ELECTRONIC ASSOCIATES, INC., Long Branch, N. J. ADV. PG. 9
Electronic Computer Corp., 160 Avenue of the Americas, New York 13, N. Y.
Engineering Research Associates, Inc., 1902 W. Minnehaha Ave., St. Paul 4, Minn.
Ford Instrument Co., 31-10 Thomson Ave., Long Island City, N. Y.
GENERAL ELECTRIC CO., Apparatus Sales Div., Schenectady 5, N. Y. ADV. PGS. 2-5
Goodyear Aircraft Corp., Akron 15, Ohio
Hogan Laboratories, Inc., 155 Perry St., New York 14, N. Y.
Jacobs Instrument Co., 4718 Bethesda Ave., Bethesda, Md.
LABORATORY FOR ELECTRONICS, INC., 43 Leon St., Boston 15, Mass. ADV. PG. 15
Leland Instruments Ltd., 22-23 Millbank, London, S. W. 1, England
Librascope, Inc., 1607 Flower St., Glendale 1, Calif.
Melpar Inc., 452 Swann Ave., Alexandria, Va.
Miller Corp., William, 325 N. Halstead Ave., Pasadena 8, Calif.
Minnesota Electronics Corp., 47 W. Water St., St. Paul 1, Minn.
NUCLEAR DEVELOPMENT ASSOCIATES, INC., 80 Grand St., White Plains, N. Y. ADV. PG. 110
Nuclear Specialty Co., P. O. Box 455, Center Moriches, N. Y.
Pacific Division, Bendix Aviation Corp., 11600 Sherman Way, North Hollywood, Calif.
Potter Instrument Co., 115 Cutter Mill Rd., Great Neck, N. Y.
Radiation Counter Labs., Inc., 1844 W. 21st St., Chicago 8, Ill.
Raytheon Mfg. Co., Equipment Sales Div., Waltham 54, Mass.

Riedel Engineering, 2351 Riverside Drive, Los Angeles 39, Calif.
Servo Corp. of America, 2020 Jericho Turnpike, New Hyde Park, N. Y.
SERVOMECHANISMS, INC., Post & Stewart Aves., Westbury, N. Y. ADV. PG. 109
T. L. G. Electric Corp., 31 W. 27th St., New York 1, N. Y.
TECHNITROL ENGINEERING CORP., 2751 N. 4th St., Philadelphia 33, Pa. ADV. PG. 132
Vectron, Inc., 400 Main St., Waltham 54, Mass.
Walkirt Co., 145 W. Hazel, Inglewood, Calif.

CONNECTORS—Electrical

AMERICAN PHENOLIC CORP., 1830 S. 54th Ave., Chicago 50, Ill. ADV. PG. 100
Cannon Electric Co., 3209 Humboldt St., Los Angeles, Calif.
Elco Corporation, 190 W. Glenwood Ave., Philadelphia 40, Pa.
Scintilla Magneto Div., Bendix Aviation Corp., Sidney, N. Y.
Tiffelex, Inc., 500 Frelinghuysen Ave., Newark 5, N. J.
WINCHESTER ELECTRONICS, INC., Glenbrook, Conn. ADV. PG. 119

CONTAINERS—Acid Proof

Atlas Mineral Products Co., 131 Norman St., Mertztown, Pa.
BAR-RAY PRODUCTS, INC., 209 25th St., Brooklyn 32, N. Y. ADV. PG. 112
Belke Mfg. Co., 947 N. Cicero Ave., Chicago 51, Ill.
Consolidated Siphon Supply Co., Inc., 24 Wooster St., New York, N. Y.
Corning Glass Works, Corning, N. Y.
Division Lead Co., 836 W. Kinzie St., Chicago 22, Ill.
General Ceramics & Steatite Corp., 250 Crows Mill Rd., Keasbey, N. J.
Goodrich Co., B. F., Akron, Ohio
Knight, Maurice A., 171 Kelly Ave., Akron, Ohio
National Lead Co., 111 Broadway, New York 6, N. Y.
Pabst Engineering Equipment Co., Inc., Elizabeth, N. J.
Polymer Corp. of Penna., The, Reading, Pa.
U. S. Stoneware Co., Akron 9, Ohio

CONTAINERS—Glass

Armstrong Cork Co., 1010 Concord St., Lancaster, Pa.
Corning Glass Works, Corning, N. Y.
Daylight Vacuum Products Co., 5207 N. Milwaukee Ave., Chicago 30, Ill.
Paragon Glass Works, Inc., 963 Newark Ave., Elizabeth 3, N. J.
Special Glass Products Co., 2 W. 33rd St., New York, N. Y.
Scientific Glass Apparatus Co., Inc., 100 Lakewood Terrace, Bloomfield, N. J.
Wakefield Industries, Inc., 5108 Grove St., Skokie, Ill.
Yonkers Laboratory Supply Co., 70 Palisade Ave., Yonkers 2, N. Y.

CONTAINERS—Glass Lined

Pfaudler Co., 1002 West Ave., Rochester, N. Y.

CONTAINERS—Hard Rubber

Belke Mfg. Co., 947 N. Cicero Ave., Chicago 51, Ill.
Luzerne Rubber Co., Dewey St., Trenton, N. J.
U. S. Rubber Co., 1230 Avenue of the Americas, New York 20, N. Y.

CONTAINERS—Lead or Lead Lined

Alpha Metals Inc., P. O. Box 34, 56 Water St., Jersey City, N. J.
American Smelting & Refining Co., 120 Broadway, New York 5, N. Y.
Atomlab, Inc., 489 Fifth Ave., New York 17, N. Y.
BAR-RAY PRODUCTS INC., 209 25th St., Brooklyn 32, N. Y. ADV. PG. 112
Belke Mfg. Co., 947 N. Cicero Ave., Chicago 51, Ill.
Bohn Wood Products Co., Route 30 E, Fort Wayne, Ind.
Division Lead Co., 836 W. Kinzie St., Chicago 22, Ill.
El-Tronics, Inc., 2649 N. Howard St., Philadelphia 33, Pa.
Federated Metals Div., American Smelting & Refining Co., 120 Broadway, New York 5, N. Y.
ISOTOPE SPECIALTIES CO., 3816 San Fernando Rd., Glendale, Calif. ADV. PG. 94
Kling Metal Spinning Co., 174 Centre St., New York 13, N. Y.
Metal Products Corp., 48 W. 19th St., Weehawken, N. J.
National Lead Co., 111 Broadway, New York 6, N. Y.
NUCLEAR INSTRUMENT & CHEMICAL CORP., 223 W. Erie St., Chicago 10, Ill. ADV. PG. Back Cover
Pabst Engineering Equipment Co., Inc., Elizabeth, N. J.
Radiation Counter Labs., Inc., 1844 W. 21st St., Chicago 8, Ill.
Radium Chemical Co., 161 E. 42nd St., New York 17, N. Y.
Radioisotope Application Co., 1843 University Ave., Berkeley 3, Calif.
Scientific Service, Inc., 1417 Solano Ave., Albany, Calif.
TECHNICAL ASSOCIATES, INC., 140 W. Providencia Ave., Burbank, Calif. ADV. PG. 130
TRACERLAB, INC., 130 High St., Boston 10, Mass. ADV. PG. 24
U. S. Stoneware Co., Akron 9, Ohio
Wirz, Inc., A. H., Chester, Pa.

CONTAINERS—Metal

Aluminum Co. of America, 801 Gulf Bldg., Pittsburgh, Pa.
BAR-RAY PRODUCTS, INC., 209 25th St., Brooklyn 32, N. Y. ADV. PG. 112
Bristol Metal Products Corp., Bristol, Tenn.
Canister Co., Inc., Phillipsburg, N. J.
Consolidated Siphon Supply Co., 24 Wooster St., New York, N. Y.
Cutler Metal Products Co., Camden, N. J.
Durlach Can & Iron Works, 168 7th, Brooklyn, N. Y.
Emerson-Sack-Warner Corp., 150 Dorchester Ave., Boston 23, Mass.
Falstrom Co., 7 Falstrom Court, Passaic, N. J.
Harford Metal Products, Inc., P. O. Box 459, Aberdeen, Md.
Houston Blow Pipe & Sheet Metal Works, P. O. Box 1692, Houston 1, Texas
Kling Metal Spinning Co., 174 Centre St., New York 13, N. Y.
Linde Air Products Co., Div. of Union Carbide & Carbon Corp., 30 E. 42nd St., New York 17, N. Y.
Metal Products Corp., 48 W. 19th St., Weehawken, N. J.
Radiation Counter Labs., Inc., 1844 W. 21st St., Chicago 8, Ill.
Wirz, Inc., A. H., Chester, Pa.

CONTAINERS—Paper

Canister Co., Inc., Phillipsburg, N. J.

CONTAINERS—Plastic

Emerson & Cuming Co., 126 Massachusetts Ave., Boston, Mass.
General Cement Co., 919 Taylor Ave., Rockford, Ill.
General Electric Co., Chemical Div., 1 Plastics Ave., Pittsfield, Mass.
Gits Molding Corp., 4600 W. Huron St., Chicago 44, Ill.
Keller Products, Inc., Manchester, N. H.
Pabst Engineering Equipment Co., Inc., Elizabeth, N. J.
Phipps & Bird, Inc., 303 S. 6th St., Richmond 5, Va.
Radiation Counter Labs., Inc., 1844 W. 21st St., Chicago 8, Ill.
Spaulding Fibre Co., Inc., 310 Wheeler St., Tonawanda, N. Y.
U. S. Stoneware Co., Akron 9, Ohio
Yonkers Laboratory Supply Co., 70 Palisade Ave., Yonkers 2, N. Y.

CONTAINERS—Stoneware

General Ceramics & Steatite Corp., 250 Crows Mill Rd., Keasbey, N. J.
Knight, Maurice A., 171 Kelly Ave., Akron, Ohio
U. S. Stoneware Co., Akron 9, Ohio

CONTROLLERS—Proportioning

Arma Corp., 254 36th St., Brooklyn 32, N. Y.
Automatic Temperature Control Co., Inc., 5206 Pulaski Ave., Philadelphia 44, Pa.
Bristol Co., The, Waterbury 20, Conn.
Builders-Providence, Inc., P. O. Box 1342, Providence 1, R. I.
Fischer & Porter Co., 50 County Line Rd., Hatboro, Pa.
Ford Instrument Co., 31-10 Thomson Ave., Long Island City, N. Y.
Foxboro Co., 38 Neponset Ave., Foxboro, Mass.
Hays Corp., Michigan City, Ind.
Industrial Controls, Inc., 525 N. Noble St., Chicago 22, Ill.
Infilco, Inc., P. O. Box 5033, Tucson, Ariz.
Lapp Insulator Co., Inc., 31 Gilbert St., LeRoy, N. Y.
Leahy Mfg. Co., East 8th & Alameda, Los Angeles, 21, Calif.
Leeds & Northrup Co., 4970 Stenton Ave., Philadelphia 44, Pa.
Precision Scientific Co., 3737 W. Cortland St., Chicago 47, Ill.
Robinette Co., W. C., 802 Fair Oaks Ave., South Pasadena, Calif.
Vectron, Inc., 400 Main St., Waltham 54, Mass.

CONTROLS—Counting & Sorting

Airmec Laboratories, Ltd., High Wycombe, Buckinghamshire, England
Arma Corp., 254 36th St., Brooklyn 32, N. Y.
Automatic Temperature Control Co., Inc., 5206 Pulaski Ave., Philadelphia 44, Pa.
Autotron Co., Box 722, Danville, Conn.
Barnes Development Co., 213 W. Baltimore Pike, Lansdowne, Pa.
Berkeley Scientific Div. of Beckman Instruments, 2200 Wright Ave., Richmond, Calif.
Berkshire Laboratories, 588 Beaver Pond Rd., Lincoln, Mass.
Bristol Co., The, Waterbury 20, Conn.
Computer Research Corp., 3348 W. El Segundo Blvd., Hawthorne, Calif.
Electrodyne Co., 32 Oliver St., Boston, Mass.
Electro-Physics Corp., 287 Broadway, New York 7, N. Y.
Engineering Research Associates, Inc., 1902 W. Minnehaha Ave., St. Paul 4, Minn.
GENERAL ELECTRIC CO., Apparatus Sales Div., Schenectady 5, N. Y. ADV. PGS. 2-5
Industrial Controls, Inc., 525 N. Noble St., Chicago 22, Ill.
Magnaflux Corp., 5900 Northwest Highway, Chicago 31, Ill.
Magnetic Amplifiers, Inc., 632 Tinton Ave., New York 55, N. Y.
North American Philips Co., Inc., 100 E. 42nd St., New York 17, N. Y.
Photobell Company, 116 Nassau St., New York 7, N. Y.
Photoswitch, Inc., 77 Broadway, Cambridge, Mass.
Potter Instrument Co., 115 Cutter Mill Rd., Great Neck, N. Y.
Production Instrument Co., 710 W. Jackson Blvd., Chicago 6, Ill.
RADIATION INSTRUMENT DEVELOPMENT LAB., 2337 W. 67th St., Chicago 36, Ill. ADV. PG. Inside Back Cover
Square Root Mfg. Corp., 391 Saw Mill River Rd., Yonkers, N. Y.
Standard Electronics Research Corp., 2 East End Ave., New York 21, N. Y.

CONTROLS—Film Thickness

Automatic Temperature Control Co., Inc., 5206 Pulaski Ave., Philadelphia 44, Pa.
Baldwin Instrument Co., Ltd., Brooklands Works, Dartford, Kent, England
Electrodyne Co., 32 Oliver St., Boston, Mass.
COLE, LTD., E. K., Electronics Div., Melmesbury, Wiltshire, England. ADV. PG. 28
Foxboro Co., 38 Neponset Ave., Foxboro, Mass.
Gulton Mfg. Corp., 212 Durham Ave., Metuchen, N. J.
Industrial Controls, Inc., 525 N. Noble St., Chicago 22, Ill.
Industrial Nucleonics Corp., 1205 Chesapeake Ave., Columbus 12, Ohio
Magnaflux Corp., 5900 Northwest Highway, Chicago 31, Ill.
Ohmart Corp., The, 2347 Ferguson Ave., Cincinnati 38, Ohio
Perkin-Elmer Corp., Norwalk, Conn.
RADIOACTIVE PRODUCTS INC., 443 W. Congress St., Detroit, Mich. ADV. PG. 8
SERVOMECHANISMS, INC., Post & Stewart Aves., Westbury, N. Y. ADV. PG. 109
Standard Electronics Research Corp., 2 East End Ave., New York 21, N. Y.
TRACERLAB, INC., 130 High St., Boston 10, Mass. ADV. PG. 24

CONTROLS—Fluid Flow

Air Associates Inc., Teterboro, N. J.
Alloy Steel Products Co., 1500 W. Elizabeth Ave., Linden, N. J.
Askania Regulator Co., 240 E. Ontario St., Chicago 11, Ill.
ASSOCIATED VALVE & ENGINEERING CO., 1150 W. Marquette Rd., Chicago 21, Ill. ADV. PG. 132
Automatic Temperature Control Co., Inc., 5206 Pulaski Ave., Philadelphia 44, Pa.
Builders-Providence, Inc., P. O. Box 1342, Providence 1, R. I.
Bristol Co., The, Waterbury 20, Conn.
Brooks Rotameter Co., Box A-1347, Lansdale, Pa.
Caltron Co., 1406 S. Hobart Blvd., Los Angeles 6, Calif.
Conoflow Corp., 2100 Arch St., Philadelphia 3, Pa.
Daylight Vacuum Products Co., 5207 N. Milwaukee Ave., Chicago 30, Ill.
Denison Engineering Co., 1186 Dublin Road, Columbus, Ohio
Eclipse-Pioneer Div., Bendix Aviation Corp., Teterboro, N. J.
Fischer & Porter Co., 50 County Line Rd., Hatboro, Pa.

Ford Instrument Co., 31-10 Thomson Ave., Long Island City, N. Y.
Foxboro Co., 38 Neponset Ave., Foxboro, Mass.
Fulton Sylphon Division, Robertshaw-Fulton Controls Co., Knoxville 4, Tenn.
General Controls Co., Glendale 1, Calif.
Gulton Mfg. Corp., 212 Durham Ave., Metuchen, N. J.
Hammel-Dahl Co., 175 Post Rd., (Warwick) Providence 5, R. I.
Hays Corp., Michigan City, Ind.
Industrial Controls, Inc., 525 N. Noble St., Chicago 22, Ill.
Inflico, Inc., P. O. Box 5033, Tucson, Ariz.
Kahl Scientific Instrument Corp., Box 1166, El Cajon, Calif.
Kackley Co., O. C., 400 W. Madison St., Chicago 6, Ill.
Kieley & Mueller, Inc., North Bergen, N. J.
Leahy Mfg. Co., East 8th & Alameda, Los Angeles 21, Calif.
Leeds & Northrup Co., 4970 Stenton Ave., Philadelphia 44, Pa.
Minneapolis-Honeywell Regulator Co., 2753 Fourth Ave. S., Minneapolis, Minn.
MINNEAPOLIS-HONEYWELL REGULATOR CO., Wayne & Roberts Aves., Philadelphia 44, Pa. ADV. PG. 29
Phoenix Precision Instrument Co., 3803-05 North 5th St., Philadelphia, Pa.
Robinette Co., W. C., 802 Fair Oaks Ave., South Pasadena, Calif.
Swartwout Co., 18547 Euclid Ave., Cleveland, Ohio
Taylor Instrument Companies, 95 Ames St., Rochester, N. Y.
U. S. Gauge Div., American Machine & Metals, Inc., Sellersville, Pa.

CONTROLS—Humidity

American Instrument Co., Inc., 8030 Georgia Ave., Silver Spring, Md.
Automatic Temperature Control Co., Inc., 5206 Pulaski Ave., Philadelphia 44, Pa.
Bristol Co., The, Waterbury 20, Conn.
Colloid Equipment Co., Inc., 50 Church St., New York 7, N. Y.
Daylight Vacuum Products Co., 5207 N. Milwaukee Ave., Chicago 30, Ill.
Eclipse-Pioneer Div., Bendix Aviation Corp., Teterboro, N. J.
Foxboro Co., 38 Neponset Ave., Foxboro, Mass.
General Controls Co., Glendale 1, Calif.
Hammel-Dahl Co., 175 Post Rd., (Warwick) Providence 5, R. I.
Industrial Controls, Inc., 525 N. Noble St., Chicago 22, Ill.
Johnson Service Co., 507 E. Michigan St., Milwaukee 2, Wis.
Leeds & Northrup Co., 4970 Stenton Ave., Philadelphia 44, Pa.
Minneapolis-Honeywell Regulator Co., 2753 Fourth Ave. S., Minneapolis, Minn.
MINNEAPOLIS-HONEYWELL REGULATOR CO., Wayne & Roberts Aves., Philadelphia 44, Pa. ADV. PG. 29
Powers Regulator Co., 3400 Oakton, Skokie, Ill.
Serden, Inc., 91 Cambridge St., Boston, Mass.
Taylor Instrument Companies, 95 Ames St., Rochester, N. Y.
Thermo Instrument Co., 1265 Old County Rd., Belmont, Calif.
WESTON ELECTRICAL INSTRUMENT CORP., 614 Frelinghuysen Ave., Newark 5, N. J. ADV. PG. 102

CONTROLS—Indicating, Millivoltmeter

Bristol Co., The, Waterbury 20, Conn.
Fieldon Instrument Division, Robertshaw-Fulton Controls Co., 2920 N. 4th St., Philadelphia 33, Pa.
Foxboro Co., 38 Neponset Ave., Foxboro, Mass.
General Controls Co., Glendale 1, Calif.
Industrial Controls, Inc., 525 N. Noble St., Chicago 22, Ill.
Leeds & Northrup Co., 4970 Stenton Ave., Philadelphia 44, Pa.
Minneapolis-Honeywell Regulator Co., 2753 Fourth Ave. S., Minneapolis, Minn.
MINNEAPOLIS-HONEYWELL REGULATOR CO., Wayne & Roberts Aves., Philadelphia 44, Pa. ADV. PG. 29
Pyrometer Instrument Co., Inc., Bergenfield, N. J.
Simpson Electric Co., Div. of American Gage & Machine Co., 5208 W. Kinzie St., Chicago 44, Ill.
Square Root Mfg. Corp., 391 Saw Mill River Rd., Yonkers, N. Y.
Taco West Corp., 525 N. Noble St., Chicago 22, Ill.
WESTON ELECTRICAL INSTRUMENT CORP., 614 Frelinghuysen Ave., Newark 5, N. J. ADV. PG. 102
Wheelco Instrument Co., 847 W. Harrison St., Chicago 7, Ill.

CONTROLS—Indicating, Millivoltmeter, Pyrometer

Bristol Co., The, Waterbury 20, Conn.
Electric Hotpack Co., Inc., 5035 Cottman Ave., Philadelphia, Pa.
Fieldon Instrument Division, Robertshaw-Fulton Controls Co., 2920 N. 4th St., Philadelphia 33, Pa.
Foxboro Co., 38 Neponset Ave., Foxboro, Mass.
Industrial Controls, Inc., 525 N. Noble St., Chicago 22, Ill.
Leeds & Northrup Co., 4970 Stenton Ave., Philadelphia 44, Pa.
Minneapolis-Honeywell Regulator Co., 2753 Fourth Ave. S., Minneapolis, Minn.
MINNEAPOLIS-HONEYWELL REGULATOR CO., Wayne & Roberts Aves., Philadelphia 44, Pa. ADV. PG. 29
Pyrometer Instrument Co., Inc., Bergenfield, N. J.
Square Root Mfg. Corp., 391 Saw Mill River Rd., Yonkers, N. Y.
Taco West Corp., 525 N. Noble St., Chicago 22, Ill.
WESTON ELECTRICAL INSTRUMENT CORP., 614 Frelinghuysen Ave., Newark 5, N. J. ADV. PG. 102
Wheelco Instrument Co., 847 W. Harrison St., Chicago 7, Ill.

CONTROLS—Liquid Level

Alco Valve Co., 865 Kingsland Ave., St. Louis 5, Mo.
Allen-Bradley Co., 136 W. Greenfield Ave., Milwaukee 4, Wis.
Askania Regulator Co., 240 E. Ontario St., Chicago 11, Ill.
ASSOCIATED VALVE & ENGINEERING CO., 1150 W. Marquette Rd., Chicago 21, Ill. ADV. PG. 132
Automatic Temperature Control Co., Inc., 5206 Pulaski Ave., Philadelphia 44, Pa.
Bogue Electric Mfg. Co., 52 Iowa Ave., Paterson 3, N. J.
Bristol Co., The, Waterbury 20, Conn.
Builders-Providence, Inc., P. O. Box 1342, Providence 1, R. I.
Colloid Equipment Co., Inc., 50 Church St., New York 7, N. Y.
Conoflow Corp., 2100 Arch St., Philadelphia 3, Pa.
Consolidated Siphon Supply Co., Inc., 24 Worster St., New York, N. Y.
Cutler-Hammer, Inc., 412 No. 12th St., Milwaukee 1, Wis.
Eclipse Fuel Engineering Co., 705 S. Main St., Rockford, Ill.
Eclipse-Pioneer Div., Bendix Aviation Corp., Teterboro, N. J.
Fieldon Instrument Division, Robertshaw-Fulton Controls Co., 2920 N. 4th St., Philadelphia 33, Pa.
Fischer & Porter Co., 50 County Line Rd., Hatboro, Pa.
Foxboro Co., 38 Neponset Ave., Foxboro, Mass.
General Controls Co., Glendale 1, Calif.
Guardian Electric Co., 1625 W. Walnut St., Chicago 12, Ill.
Gulton Mfg. Corp., 212 Durham Ave., Metuchen, N. J.
Hammel-Dahl Co., 175 Post Rd., (Warwick) Providence 5, R. I.
Hays Corp., Michigan City, Ind.
Industrial Controls, Inc., 525 N. Noble St., Chicago 22, Ill.
Inflico, Inc., P. O. Box 5033, Tucson, Ariz.
Isotope Products Ltd., Davis Rd., P. O. Box 127, Oakville, Ontario, Canada
Johnson Corp., 809 Wood St., Three Rivers, Mich.
Johnson Service Co., 507 E. Michigan St., Milwaukee 2, Wis.
Kahl Scientific Instrument Corp., Box 1166, El Cajon, Calif.
Kackley Co., O. C., 400 Madison St., Chicago 6, Ill.
Kieley & Mueller, Inc., North Bergen, N. J.
Leeds & Northrup Co., 4970 Stenton Ave., Philadelphia 44, Pa.
Lumenite Electric Co., 407 S. Dearborn St., Chicago 5, Ill.
Marcold Corp., 4201 Belmont Ave., Chicago 41, Ill.
Minneapolis-Honeywell Regulator Co., 2753 Fourth Ave. S., Minneapolis, Minn.
MINNEAPOLIS-HONEYWELL REGULATOR CO., Wayne & Roberts Aves., Philadelphia 44, Pa. ADV. PG. 29
Ohmart Corp., The, 2347 Ferguson Ave., Cincinnati 38, Ohio
Phoenix Precision Instrument Co., 3803-05 North 5th St., Philadelphia, Pa.
Photobell Co., 116 Nassau St., New York 7, N. Y.
Photoswitch, Inc., 77 Broadway, Cambridge, Mass.
Powers Regulator Co., 3400 Oakton, Skokie, Ill.
Process & Instruments, 60 Greenpoint Ave., Brooklyn 22, N. Y.
RADIATION INSTRUMENT DEVELOPMENT LAB., 2337 W. 67th St., Chicago 36, Ill. ADV. PG. Inside Back Cover
Ripley Co., Inc., 22 W. First St., Mt. Vernon, N. Y.
Simplex Valve & Meter Co., 68th & Upland Sts., Philadelphia 42, Pa.
Swartwout Co., 18547 Euclid Ave., Cleveland, Ohio
Taylor Instrument Companies, 95 Ames St., Rochester, N. Y.
Thermo Instruments Co., 1265 Old County Rd., Belmont, Calif.
TRACERLAB, INC., 130 High St., Boston 10, Mass. ADV. PG. 24
U. S. Gauge Div., American Machine & Metals, Inc., Sellersville, Pa.

CONTROLS—Motor

Allen-Bradley Co., 136 W. Greenfield Ave., Milwaukee, Wis.
Allis Chalmers Mfg. Co., 935 S. 70th St., Milwaukee 1, Wis.
American Relay & Controls, Inc., 4901 Flournay St., Chicago 44, Ill.
Arrow-Hart & Hegeman Electric Co., 103 Hawthorne St., Hartford, Conn.
Bogue Electric Mfg. Co., 52 Iowa Ave., Paterson 3, N. J.
Bristol Co., The, Waterbury 20, Conn.
Clark Controller Co., 1146 E. 152nd St., Cleveland 10, Ohio
Conoflow Corp., 2100 Arch St., Philadelphia 3, Pa.
Cutler-Hammer, Inc., 412 N. 12th St., Milwaukee 1, Wis.
Daylight Vacuum Products Co., 5207 N. Milwaukee Ave., Chicago 30, Ill.
Electric Machinery Mfg. Co., 1331 N. E. Tyler St., Minneapolis 13, Minn.
Ford Instrument Co., 31-10 Thomson Ave., Long Island City, N. Y.
General Controls Co., Glendale 1, Calif.
GENERAL ELECTRIC CO., Apparatus Sales Div., Schenectady 5, N. Y. ADV. PGS. 2-3
General Magnetics, Inc., 135 Bloomfield Ave., Bloomfield, N. J.
General Radio Co., 275 Massachusetts Ave., Cambridge 39, Mass.
Hays Corp., Michigan City, Ind.
Industrial Control Co., Straight Path & Arlington Ave., Wyandanch, N. Y.
Minneapolis-Honeywell Regulator Co., 2753 Fourth Ave. S., Minneapolis, Minn.
Ohmite Mfg. Co., 4835 W. Flournoy St., Chicago 44, Ill.
Raytheon Mfg. Co., Equipment Sales Div., Waltham 54, Mass.
Robinette Co., W. C., 802 Fair Oaks Ave., South Pasadena, Calif.
SERVOMECHANISMS, INC., Post & Stewart Aves., Westbury, N. Y. ADV. PG. 109
Small Motors, Inc., 2076 Elston Ave., Chicago 14, Ill.
Square Root Mfg. Corp., 391 Saw Mill River Rd., Yonkers, N. Y.
Standard Electronics Research Corp., 2 East End Ave., New York 21, N. Y.
Trumbull Electric Dept. of General Electric Co., 41 Woodford Ave., Plainville, Conn.
Vickers Electric Division, Vickers, Inc., 1815 Locust St., St. Louis, Mo.
Ward Leonard Electric Co., 31 South St., Mt. Vernon, N. Y.
Westinghouse Electric Corp., P. O. Box 868, Pittsburgh 30, Pa.

CONTROLS—Nuclear Reactor

Arma Corp., 254 36th St., Brooklyn 32, N. Y.
Radiation Counter Labs., Inc., 1844 W. 21st St., Chicago 8, Ill.

CONTROLS—Pressure

Allen-Bradley Co., 136 W. Greenfield Ave., Milwaukee 4, Wis.
American Oxygen Service Corp., 600 Essex St., Harrison, N. J.
Askania Regulator Co., 240 E. Ontario St., Chicago 11, Ill.
ASSOCIATED VALVE & ENGINEERING CO., 1150 W. Marquette Rd., Chicago 21, Ill. ADV. PG. 132
Audio Instrument Co., 113 W. 14th St., New York 11, N. Y.
Automatic Temperature Control Co., Inc., 5206 Pulaski Ave., Philadelphia 44, Pa.
Bristol Co., The, Waterbury 20, Conn.
Conoflow Corp., 2100 Arch St., Philadelphia 3, Pa.
Coral Designs Div., Henry G. Dietz Co., 12-16 Astoria Blvd., Long Island City 2, N. Y.
Cutler-Hammer Inc., 412 N. 12th St., Milwaukee 1, Wis.
Denison Engineering Co., 1186 Dublin Road, Columbus, Ohio
Eclipse Fuel Engineering Co., 705 S. Main St., Rockford, Ill.
Eclipse-Pioneer Div., Bendix Aviation Corp., Teterboro, N. J.
Fischer & Porter Co., 50 County Line Rd., Hatboro, Pa.
Ford Instrument Co., 31-10 Thomson Ave., Long Island City, N. Y.
Foxboro Co., 38 Neponset Ave., Foxboro, Mass.
Fulton Sylphon Division, Robertshaw-Fulton Controls Co., Knoxville 4, Tenn.

Gas & Oil Industry Laboratories, Inc., 2 Paine Ave., Irvington 11, N. J.
General Controls Co., Glendale 1, Calif.
General Regulator Corp., 165 Broadway, New York 6, N. Y.
Giannini & Co., G. M., 254 W. Colorado St., Pasadena 1, Calif.
Gulton Mfg. Corp., 212 Durham Ave., Metuchen, N. J.
Hammel-Dahl Co., 175 Post Rd., (Warwick) Providence 5, R. I.
Industrial Controls, Inc., 525 N. Noble St., Chicago 22, Ill.
Kackley Co., O. C., 400 Madison St., Chicago 6, Ill.
Kisley & Mauller, Inc., North Bergen, N .J.
Leahy Mfg. Co., East 8th & Alameda, Los Angeles 21, Calif.
Manning, Maxwell & Moore, Inc., Stratford, Conn.
Mercoid Corp., 4201 Belmont Ave., Chicago 41, Ill.
Minneapolis-Honeywell Regulator Co., 2753 Fourth Ave., S., Minneapolis, Minn.
MINNEAPOLIS-HONEYWELL REGULATOR CO., Wayne & Roberts Aves., Philadelphia 44, Pa. ADV. PG. 29
Powers Regulator Co., 3400 Oakton, Skokie, Ill.
Rahm Instruments, Inc., 12 West Broadway, New York 7, N. Y.
Robinette Co., W. C., 802 Fair Oaks Ave., South Pasadena, Calif.
SERVOMECHANISMS, INC., Post & Stewart Aves., Westbury, N. Y. ADV. PG. 109
Swartwout Co., 18457 Euclid Ave., Cleveland, Ohio
Taylor Instrument Companies, 95 Ames St., Rochester, N. Y.
U. S. Gauge Div., American Machine & Metals, Inc., Sellersville, Pa.
Wallace & Tiernan Products, Inc., Belleville 9, N. J.
Wekslar Thermometer Corp., Martinique Bldg., 49 W. 32nd St., New York 1, N. Y.
Westinghouse Electric Corp., P. O. Box 868, Pittsburgh 30, Pa.
WESTON ELECTRICAL INSTRUMENT CORP., 614 Frelinghuysen Ave., Newark 5, N. J. ADV. PG. 102

CONTROLS—Remote

Air Associates, Inc., Teterboro, N. J.
Allis-Chalmers Mfg. Co., 935 S. 70th St., Milwaukee 1, Wis.
Applied Science Corp. of Princeton, P. O. Box 44, Princeton, N. J.
Arma Corp., 254 36th St., Brooklyn 32, N. Y.
Askania Regulator Co., 240 E. Ontario St., Chicago 11, Ill.
Audio Instrument Co., 113 W. 14th St., New York 11, N. Y.
Austin Co., Special Devices Div., 76 Ninth Ave., New York 11, N. Y.
Automatic Temperature Control Co., Inc., 5206 Pulaski Ave., Philadelphia 44, Pa.
Avion Instrument Corp., Paramus, N. J.
Bogue Electric Mfg. Co., 52 Iowa Ave., Paterson 3, N. J.
Bristol Co., The, Waterbury 20, Conn.
C. G. S. Laboratories, Inc., 391 Ludlow St., Stamford, Conn.
Collins Radio Co., Cedar Rapids, Iowa
Communications Co., Inc., 300 Greco Ave., Coral Gables 34, Fla.
Conoflow Corp., 2100 Arch St., Philadelphia 3, Pa.
Cutler-Hammer, Inc., 412 N. 12th St., Milwaukee 1, Wis.
Eclipse-Pioneer Div., Bendix Aviation Corp., Teterboro, N. J.
Elm Laboratories, 18 South Broadway, Dobbs Ferry, N. Y.
El-Tronics, Inc., 2649 N. Howard St., Philadelphia 33, Pa.
Foxboro Co., 38 Neponset Ave., Foxboro, Mass.
General Controls Co., Glendale 1, Calif.
General Magnetics, Inc., 135 Bloomfield Ave., Bloomfield, N. J.
General Regulator Corp., 165 Broadway, New York 6, N. Y.
Guardian Electric Co., 1625 W. Wainut St., Chicago 12, Ill.
Hammel-Dahl Co., 175 Post Rd., (Warwick) Providence 5, R. I.
HAMMARLUND MFG. CO., 460 W. 34th St., New York 1, N. Y. ADV. PG. 113
Industrial Control Co., Straight Path & Arlington Ave., Wyandanch, N. Y.
Industrial Controls, Inc., 525 N. Noble St., Chicago 22, Ill.
Kisley & Mauller, Inc., North Bergen, N. J.
Kupfrian Mfg. Co., 139 Prospect Ave., Binghamton, N. Y.
Minneapolis-Honeywell Regulator Co., 2753 Fourth Ave. S., Minneapolis, Minn.
MINNEAPOLIS-HONEYWELL REGULATOR CO., Wayne & Roberts Aves., Philadelphia 44, Pa. ADV. PG. 29
Patterson, Moos & Co., Inc., 32-36 47th Ave., Long Island City 1, N. Y.
Precision Scientific Co., 3737 W. Cortland St., Chicago 47, Ill.
Robinette Co., W. C., 802 Fair Oaks Ave., South Pasadena, Calif.
SERVOMECHANISMS, INC., Post & Stewart Aves., Westbury, N. Y. ADV. PG. 109
Square Root Mfg. Corp., 391 Saw Mill River Rd., Yonkers, N. Y.
Standard Electronics Research Corp., 2 East End Ave., New York 21, N. Y.
Swartwout Co., 18547 Euclid Ave., Cleveland, Ohio
T. L. G. Electric Corp., 31 W. 27th St., New York 1, N. Y.
Taylor Instrument Companies, 95 Ames St., Rochester, N. Y.
Tech Laboratories, Inc., Bergen & Edsall Blvds., Palisades Park, N. J.
Telectro Industries Corp., 35-18 37th St., Long Island City 1, N. Y.
Vectron, Inc., 400 Main St., Waltham 54, Mass.
Vickers Electric Division, Vickers, Inc., 1815 Locust St., St. Louis, Mo.
Westinghouse Electric Corp., P. O. Box 868, Pittsburgh 30, Pa.
WESTON ELECTRICAL INSTRUMENT CORP., 614 Frelinghuysen Ave., Newark 5, N. J. ADV. PG. 102
White Dental Mfg. Co., S. S., 10 E. 40th St., New York, N. Y.

CONTROLS—Servo

Air Associates, Inc., Teterboro, N. J.
American Electric Motors, Inc., 4811-13 Telegraph Rd., Los Angeles, Calif.
Arma Corp., 254 36th St., Brooklyn 32, N. Y.
Askania Regulator Co., 240 E. Ontario St., Chicago 11, Ill.
Atomlab, Inc., 489 Fifth Ave., New York 17, N. Y.
Austin Co., Special Devices Div., 76 Ninth Ave., New York 11, N. Y.
Automatic Temperature Control Co., Inc., 5206 Pulaski Ave., Philadelphia 44, Pa.
Avion Instrument Corp., Paramus, N. J.
Bogue Electric Mfg. Co., 52 Iowa Ave., Paterson 3, N. J.
Bristol Co., The, Waterbury 20, Conn.
C. G. S. Laboratories, Inc., 391 Ludlow St., Stamford, Conn.
Doelcam Corp., 56 Elmwood St., Newton, Mass.
Eclipse-Pioneer Div., Bendix Aviation Corp., Teterboro, N. J.
Electro-Mec Laboratory, 19 Murray St., New York 7, N. Y.
El-Tronics, Inc., 2649 N. Howard St., Philadelphia 33, Pa.
Ford Instrument Co., 31-10 Thomson Ave., Long Island City, N. Y.
Gaveco Labs., Inc., 2 East End Ave., New York 21, N. Y.
GENERAL ELECTRIC CO., Apparatus Sales Div., Schenectady 5, N. Y. ADV. PGS. 2-3
General Magnetics, Inc., 135 Bloomfield Ave., Bloomfield, N. J.
General Regulator Corp., 165 Broadway, New York 6, N. Y.
Industrial Control Co., Straight Path & Arlington Ave., Wyandanch, N. Y.
Industrial Controls, Inc., 525 N. Noble St., Chicago 22, Ill.
Krohn-Hite Instrument Co., 580 Massachusetts Ave., Cambridge 39, Mass.
Librascope, Inc., 1607 Flower St., Glendale 1, Calif.
Magnetic Amplifiers, Inc., 632 Tinton Ave., New York 55, N. Y.
Manning, Maxwell & Moore, Inc., Stratford, Conn.
Minneapolis-Honeywell Regulator Co., 2753 Fourth Ave. S., Minneapolis, Minn.
Muirhead & Co., Ltd., Beckenham, Kent, England
Nuclear Specialty Co., P. O. Box 455, Center Moriches, N. Y.
Patterson, Moos & Co., Inc., 32-36 47th Ave., Long Island City 1, N. Y.
Raytheon Mfg. Co., Equipment Sales Div., Waltham 54, Mass.
Reeves Instrument Corp., 215 E. 91st St., New York 28, N. Y.
Robinette Co., W. C., 802 Fair Oaks Ave., South Pasadena, Calif.
Sanders Associates, Inc., Nashua, N. H.
Servo Corp. of America, 2020 Jericho Turnpike, New Hyde Park, N. Y.
Servo-Tek Products Co., 4 Godwin Ave., Paterson 1, N. J.
SERVOMECHANISMS, INC., Post & Stewart Aves., Westbury, N. Y. ADV. PG. 109
Sherron Electronics Co., 1201 Flushing Ave., Brooklyn 6, N. Y.
Square Root Mfg. Corp., 391 Saw Mill River Rd., Yonkers, N. Y.
Standard Electronics Research Corp., 2 East End Ave., New York 21, N. Y.
T. L. G. Electric Corp., 31 W. 27th St., New York 1, N. Y.
Taylor Instrument Companies, 95 Ames St., Rochester, N. Y.
Trans-Sonics, Inc., Bedford Airport, Bedford, Mass.
Vectron, Inc., 400 Main St., Waltham 54, Mass.
Vickers Electric Division, Vickers, Inc., 1815 Locust St., St. Louis, Mo.

CONTROLS—Specific Gravity

Automatic Temperature Control Co., Inc., 5206 Pulaski Ave., Philadelphia 44, Pa.
Bristol Co., The, Waterbury 20, Conn.
Fischer & Porter Co., 50 County Line Rd., Hatboro, Pa.
Foxboro Co., 38 Neponset Ave., Foxboro, Mass.
Hays Corp., Michigan City, Ind.
Industrial Controls, Inc., 525 N. Noble St., Chicago 22, Ill.
Isotope Products Ltd., Davis Rd., P. O. Box 127, Oakville, Ontario, Canada
Leeds & Northrup Co., 4970 Stenton Ave., Philadelphia 44, Pa.
Minneapolis-Honeywell Regulator Co., 2753 Fourth Ave. S., Minneapolis, Minn.
Ohmart Corp., The, 2347 Ferguson Ave., Cincinnati 38, Ohio
Scientific Glass Apparatus Co., Inc., 100 Lakewood Terrace, Bloomfield, N. J.
Taylor Instrument Companies, 95 Ames St., Rochester, N. Y.

CONTROLS—Temperature

Allen-Bradley Co., 136 W. Greenfield Ave., Milwaukee 4, Wis.
American Instrument Co., Inc., 8030 Georgia Ave., Silver Spring, Md.
BAR-RAY PRODUCTS, INC., 209 25th St., Brooklyn 32, N. Y. ADV. PG. 112
Bogue Electric Mfg. Co., 52 Iowa Ave., Paterson 3, N. J.
Bristol Co., The, Waterbury 20, Conn.
Caroline & Sitter, 12 H St., N.E., Washington 11, D. C.
Cutler-Hammer Inc., 412 N. 12th St., Milwaukee 1, Wis.
Eclipse Fuel Engineering Co., 705 S. Main St., Rockford, Ill.
Edison Inc., Thomas A., Instrument Div., West Orange, N. J.
Fenwal Inc., 120 Pleasant St., Ashland, Mass.
Fischer & Porter Co., 50 County Line Rd., Hatboro, Pa.
Fisher Scientific Co., 709 Forbes St., Pittsburgh 19, Pa.
Foxboro Co., 38 Neponset Ave., Foxboro, Mass.
Fulton Sylphon Division, Robertshaw-Fulton Controls Co., Knoxville 4, Tenn.
General Controls Co., Glendale 1, Calif.
General Magnetics, Inc., 135 Bloomfield Ave., Bloomfield, N. J.
General Regulator Corp., 165 Broadway, New York 6, N. Y.
Hagan Corp., 323 Fourth Ave., Pittsburgh 30, Pa.
Hammel-Dahl Co., 175 Post Rd., (Warwick) Providence 5, R. I.
Hays Corp., Michigan City, Ind.
Industrial Controls, Inc., 525 N. Noble St., Chicago 22, Ill.
Industrial Engineering & Equipment Co., 711 S. Theresa, St. Louis 3, Mo.
Johnson Service Co., 807 E. Michigan St., Milwaukee 2, Wis.
Kahl Scientific Instrument Corp., Box 1166, El Cajon, Calif.
Kackley Co., O. C., 400 Madison St., Chicago 6, Ill.
Kisley & Mauller, Inc., North Bergen, N. J.
Leeds & Northrup Co., 4970 Stenton Ave., Philadelphia 44, Pa.
Macdonald & Co., Inc., W. S., 33 University Rd., Cambridge 38, Mass.
Manning, Maxwell & Moore, Inc., Stratford, Conn.
Mercoid Corp., 4201 Belmont Ave., Chicago 41, Ill.
Minneapolis-Honeywell Regulator Co., 2753 Fourth Ave. S., Minneapolis, Minn.
MINNEAPOLIS-HONEYWELL REGULATOR CO., Wayne & Roberts Aves., Philadelphia 44, Pa. ADV. PG. 29
Mullard Overseas Ltd., Century House, Shaftesbury Ave., London W. C. 2, England
National Appliance Co., Swan Island, Portland 18, Ore.
Partlow Corp., The, 2 Campion Rd., New Hartford, N. Y.
Photobell Co., 116 Nassau St., New York 7, N. Y.
Powers Regulator Co., 3400 Oakton, Skokie, Ill.
Precision Scientific Co., 3737 W. Cortland St., Chicago 47, Ill.
Pyrometer Instrument Co., Inc., Bergenfield, N. J.
Servo Corp. of America, 2020 Jericho Turnpike, New Hyde Park, N. Y.
Scientific Glass Apparatus Co., Inc., 100 Lakewood Terrace, Bloomfield, N. J.
Square Root Mfg. Corp., 391 Saw Mill River Rd., Yonkers, N. Y.
Standard Electronics Research Corp., 2 East End Ave., New York 21, N. Y.
Swartwout Co., 18457 Euclid Ave., Cleveland, Ohio
Taco West Corp., 525 Noble St., Chicago 22, Ill.
Taylor Instrument Companies, 95 Ames St., Rochester, N. Y.
Telectro Industries Corp., 35-18 37th St., Long Island City 1, N. Y.
Thermo Electric Mfg. Co., 465 Huff, Dubuque, Ia.

Thwing-Albert Instrument Co., Penn St. & Pulaski Ave., Philadelphia 44, Pa.
Trans-Sonics, Inc., Bedford Airport, Bedford, Mass.
U. S. Gauge Div., American Machine & Metals, Inc., Sellersville, Pa.
Vickers Electric Division, Vickers, Inc., 1815 Locust St., St. Louis, Mo.
Weksler Thermometer Corp., Martinique Bldg., 49 W. 32nd St., New York 1, N. Y.
Westinghouse Electric Corp., P. O. Box 868, Pittsburgh 30, Pa.
WESTON ELECTRIC INSTRUMENT CORP., 614 Frelinghuysen Ave., Newark 5, N. J. ADV. PG. 102
Wheelco Instrument Co., 847 W. Harrison St., Chicago 7, Ill.

CONTROLS—Temperature, Precision

American Instrument Co., Inc., 8030 Georgia Ave., Silver Spring, Md.
BAR-RAY PRODUCTS, INC., 209 25th St., Brooklyn 32, N. Y. ADV. PG. 112
Bogue Electric Mfg. Co., 52 Iowa Ave., Paterson 3, N. J.
Bristol Co., The, Waterbury 20, Conn.
Electrodyne Co., 32 Oliver St., Boston, Mass.
Fenwal Inc., 120 Pleasant St., Ashland, Mass.
Fischer & Porter Co., 30 County Line Rd., Harbore, Pa.
Foxboro Co., 38 Neponset Ave., Foxboro, Mass.
General Controls Co., Glendale 1, Calif.
General Regulator Corp., 165 Broadway, New York 6, N. Y.
Hammel-Dahl Co., 175 Post Rd., (Warwick) Providence 5, R. I.
Industrial Controls, Inc., 525 N. Noble St., Chicago 22, Ill.
Kahl Scientific Instrument Corp., Box 1166, El Cajon, Calif.
Keckley Co., O. C., 400 W. Madison St., Chicago 6, Ill.
Leeds & Northrup Co., 4970 Stenton Ave., Philadelphia 44, Pa.
Macdonald & Co., Inc., W. S., 33 University Rd., Cambridge 38, Mass.
Manning, Maxwell & Moore, Inc., Stratford, Conn.
Minneapolis-Honeywell Regulator Co., 2753 Fourth Ave. S., Minneapolis, Minn.
MINNEAPOLIS-HONEYWELL REGULATOR CO., Wayne & Roberts Aves., Philadelphia 44, Pa. ADV. PG. 29
Mullard Overseas Ltd., Century House, Shaftesbury Ave., London W. C. 2, England
Powers Regulator Co., 3400 Oakton, Skokie, Ill.
Precision Scientific Co., 3737 W. Cortland St., Chicago 47, Ill.
Process & Instruments, 60 Greenpoint Ave., Brooklyn 22, N. Y.
Pyrometer Instrument Co., Inc., Bergenfield, N. J.
Square Root Mfg. Corp., 391 Saw Mill River Rd., Yonkers, N. Y.
Standard Electronics Research Corp., 2 East End Ave., New York 21, N. Y.
Taco West Corp., 525 N. Noble St., Chicago 22, Ill.
Taylor Instrument Companies, 95 Ames St., Rochester, N. Y.
Thwing-Albert Instrument Co., Penn St. & Pulaski Ave., Philadelphia 44, Pa.
Trans-Sonics, Inc., Bedford Airport, Bedford, Mass.
Vectron, Inc., 400 Main St., Waltham 54, Mass.
Vickers Electric Division, Vickers, Inc., 1815 Locust St., St. Louis, Mo.
Weksler Thermometer Corp., Martinique Bldg., 49 W. 32nd St., New York 1, N. Y.
WESTON ELECTRICAL INSTRUMENT CORP., 614 Frelinghuysen Ave., Newark 5, N. J. ADV. PG. 102

CONTROLS—Timing

Airmec Laboratories, Ltd., High Wycombe, Buckinghamshire, England
Allen-Bradley Co., 136 W. Greenfield Ave., Milwaukee 4, Wis.
American Electronic Laboratories, Inc., 641 Arch St., Philadelphia 6, Pa.
Askania Regulator Co., 240 E. Ontario St., Chicago 11, Ill.
Automatic Temperature Control Co., Inc., 5206 Pulaski Ave., Philadelphia 44, Pa.
Autotron Co., Box 722, Danville, Conn.
Bristol Co., The, Waterbury 20, Conn.
Cinema-Television Ltd., Worsley Bridge Rd., London, S. E. 26, England
COLE, LTD., E. K., Electronics Div., Malmesbury, Wiltshire, England. ADV. PG. 28
Colloid Equipment Co., Inc., 50 Church St., New York 7, N. Y.
Computer Research Corp., 3348 W. El Segundo Blvd., Hawthorne, Calif.
Coral Designs Div., Henry G. Dietz Co., 12–16 Astoria Blvd., Long Island City 2, N. Y.
Cramer Co., Inc., R. W., Box 13, Centerbrook, Conn.
Cutler-Hammer, Inc., 412 N. 12th St., Milwaukee 1, Wis.
Daeicam Corp., 56 Elmwood St., Newton, Mass.
Edison, Inc., Thomas A., Instrument Div., West Orange, N. J.
Eisler Engineering Co., 760 S. 13th St., Newark 3, N. J.
Electro-Physics Corp., 287 Broadway, New York 7, N. Y.
Ford Instrument Co., 31–10 Thomson Ave., Long Island City, N. Y.
Foxboro Co., 38 Neponset Ave., Foxboro, Mass.
Gale Dorothea Mechanisms, Inc., 81–01 Broadway, Elmhurst, N. Y.
General Control Company, 1200 Soldiers Field Rd., Boston 34, Mass.
General Controls Co., Glendale 1, Calif.
Gorrell & Gorrell, Haworth, N. J.
Haydon Mfg. Co., Inc., 584 E. Elm St., Torrington, Conn.
Industrial Control Co., Straight Path & Arlington Ave., Wyandanch, N. Y.
Industrial Controls, Inc., 525 N. Noble St., Chicago 22, Ill.
Lumenite Electric Co., 407 S. Dearborn St., Chicago 5, Ill.
Mallory & Co., Inc., P. R., 3029 E. Washington St., Indianapolis 6, Ind.
Marconi Instruments, Ltd., 23–25 Beaver St., New York 4, N. Y.
Minneapolis-Honeywell Regulator Co., 2753 Fourth Ave. S., Minneapolis, Minn.
Paragon Electric Company, Two Rivers, Wisconsin
Partlow Corp., The, 2 Campion Rd., New Hartford, N. Y.
Patterson, Moos & Co., Inc., 32–36 47th Ave., Long Island City 1, N. Y.
Phipps & Bird, Inc., 303 S. 6th St., Richmond 5, Va.
Photocon Research Products, 421 N. Foothill Blvd., Pasadena 7, Calif.
Photoswitch, Inc., 77 Broadway, Cambridge, Mass.
Potter Instrument Co., 115 Cutter Mill Rd., Great Neck, N. Y.
Radioisotope Application Co., 1843 University Ave., Berkeley 3, Calif.
Rutherford Electronics Corp., 3707 S. Robertson Blvd., Culver City, Calif.
Scientific Service, Inc., 1417 Solano Ave., Albany, Calif.
Square Root Mfg. Corp., 391 Saw Mill River Rd., Yonkers, N. Y.
Standard Electronics Research Corp., 2 East End Ave., New York 21, N. Y.
Taylor Instrument Companies, 95 Ames St., Rochester, N. Y.
Telectro Industries Corp., 35–18 37th St., Long Island City 1, N. Y.
Tork Clock Co., Inc., Mount Vernon, N. Y.
TRACERLAB, INC., 130 High St., Boston 10, Mass. ADV. PG. 24
U. S. Gauge Div., American Machine & Metals, Inc., Sellersville, Pa.
Vectron, Inc., 400 Main St., Waltham 54, Mass.
Weltronic Co., 19500 W. Eight Mile Rd., Detroit 19, Mich.
Westinghouse Electric Corp., P. O. Box 868, Pittsburgh 30, Pa.
WESTON ELECTRICAL INSTRUMENT CORP., 614 Frelinghuysen Ave., Newark 5, N. J. ADV. PG. 102

CONTROLS—Vacuum

Allen-Bradley Co., 136 W. Greenfield Ave., Milwaukee 4, Wis.
Askania Regulator Co., 240 E. Ontario St., Chicago 11, Ill.
ASSOCIATED VALVE & ENGINEERING CO., 1150 W. Marquette Rd., Chicago 21, Ill. ADV. PG. 132
Automatic Temperature Control Co., Inc., 5206 Pulaski Ave., Philadelphia 44, Pa.
Bristol Co., The, Waterbury 20, Conn.
Conoflow Corp., 2100 Arch St., Philadelphia 3, Pa.
Cutler-Hammer, Inc., 412 N. 12th St., Milwaukee 1, Wis.
Daylight Vacuum Products Co., 5207 N. Milwaukee Ave., Chicago 30, Ill.
DISTILLATION PRODUCTS INDUSTRIES, A Division of Eastman Kodak Co., Rochester 3, N. Y. ADV. PG. 91
Fredericks Co., George E., Bethayres, Pa.
Foxboro Co., 38 Neponset Ave., Foxboro, Mass.
Fulton Sylphon Division, Robertshaw-Fulton Controls Co., Knoxville 4, Tenn.
General Controls Co., Glendale 1, Calif.
General Regulator Corp., 165 Broadway, New York 6, N. Y.
Hammel-Dahl Co., 175 Post Rd., (Warwick) Providence 5, R. I.
Hastings Instrument Co., Super Highway at Pine Ave., Hampton, Va.
Industrial Controls, Inc., 525 N. Noble St., Chicago 22, Ill.
Kinney & Mueller, Inc., North Bergen, N. J.
Mercoid Corp., 4201 Belmont Ave., Chicago 41, Ill.
Minneapolis-Honeywell Regulator Co., 2753 Fourth Ave. S., Minneapolis, Minn.
MINNEAPOLIS-HONEYWELL REGULATOR CO., Wayne & Roberts Aves., Philadelphia 44, Pa. ADV. PG. 29
NATIONAL RESEARCH CORP., 70 Memorial Drive, Cambridge 42, Mass. ADV. PG. 16
Phillips-Drucker, 2245 S. Vandeventer Ave., St. Louis, Mo.
Powers Regulator Co., 3400 Oakton, Skokie, Ill.
Precision Scientific Co., 3737 W. Cortland St., Chicago 47, Ill.
Process & Instruments, 60 Greenpoint Ave., Brooklyn 22, N. Y.
SCIENTIFIC SPECIALTIES CORP., Snow & Union Sts., Brighton 35, Mass. ADV. PG. 122
Taylor Instrument Companies, 95 Ames St., Rochester, N. Y.
U. S. Gauge Div., American Machine & Metals, Inc., Sellersville, Pa.
Vacuum-Electronic Engineering Co., 86 Denton Ave., New Hyde Park, N. Y.
Wallace & Tiernan Products, Inc., Belleville 9, N. J.
Weksler Thermometer Corp., Martinique Bldg., 49 W. 32nd St., New York 1, N. Y.
WESTON ELECTRICAL INSTRUMENT CORP., 614 Frelinghuysen Ave., Newark 5, N. J. ADV. PG. 102

CONTROLS—Ventilating

Bristol Co., The, Waterbury 20, Conn.
Coral Designs Div., Henry G. Dietz Co., 12–16 Astoria Blvd., Long Island City 2, N. Y.
Cutler-Hammer, Inc., 412 N. 12th St., Milwaukee 1, Wis.
Fulton Sylphon Division, Robertshaw-Fulton Controls Co., Knoxville 4, Tenn.
General Controls Co., Glendale 1, Calif.
Minneapolis-Honeywell Regulator Co., 2753 Fourth Ave. S., Minneapolis, Minn.
Powers Regulator Co., 3400 Oakton, Skokie, Ill.
Westinghouse Electric Corp., P. O. Box 868, Pittsburgh 30, Pa.

CONVERTERS

Allied Radio Corp., 833 W. Jackson Blvd., Chicago 7, Ill.
Allis-Chalmers Mfg. Co., 935 S. 70th St., Milwaukee 1, Wis.
American Television & Radio Co., 300 E. Fourth St., St. Paul 1, Minn.
Arma Corp., 254 36th St., Brooklyn 32, N. Y.
ATOMIC INSTRUMENT CO., 84 Massachusetts Ave., Cambridge 39, Mass. ADV. PG. 23
Audio Instrument Co., 133 W. 14th St., New York 11, N. Y.
Bristol Co., The, Waterbury 20, Conn.
Carter Motor Co., 2644 N. Maplewood Ave., Chicago 47, Ill.
Cornell-Dubilier Electric Corp., South Plainfield, N. J.
Electro-Mechanical Research, Inc., 64 Main St., Ridgefield, Conn.
Empire Devices, Inc., 38–25 Bell Blvd., Bayside 61, N. Y.
Engineering Research Associates, Inc., 1902 W. Minnehaha Ave., St. Paul 4, Minn.
Ford Instrument Co., 31–10 Thomson Ave., Long Island City, N. Y.
GENERAL ELECTRIC CO., Apparatus Sales Div., Schenectady 5, N. Y. ADV. PGS. 2–5
General Magnetics, Inc., 135 Bloomfield Ave., Bloomfield Ave., Bloomfield, N. J.
Georator Corp., 1820 N. Nash St., Arlington, Va.
Gothard Mfg. Co., 2110 Clear Lake Ave., Springfield, Ill.
Kato Engineering Co., 1415 First Ave., Mankato, Minn.
Mallory & Co., Inc., P. R., 3029 E. Washington St., Indianapolis 6, Ind.
Raadel Engineering, 2351 Riverside Drive, Los Angeles 39, Calif.
SORENSEN & CO., INC., 375 Fairfield Ave., Stamford, Conn. ADV. PG. 125
Square Root Mfg. Corp., 391 Saw Mill River Rd., Yonkers, N. Y.
Varo Mfg. Co., Inc., Box 638, Garland, Texas
Weltronic Co., 19500 W. Eight Mile Rd., Detroit 19, Mich.
Western Blower Co., 1800 Airport Way, Seattle 66, Wash.

COUNTERS—Alpha

ABLE SCIENTIFIC GLASS APPARATUS CO., 5041 W. Lake St., Chicago 44, Ill. ADV. PGS. 108, 131, 134
Airmec Laboratories, Ltd., High Wycombe, Buckinghamshire, England
Allied Radio Corp., 833 W. Jackson Blvd., Chicago 7, Ill.
American Instrument Co., Inc., 8030 Georgia Ave., Silver Spring, Md.
ANTON ELECTRONIC LABS., INC., 1226–38 Flushing Ave., Brooklyn 37, N. Y. ADV. PG. 136
Atomlab, Inc., 489 Fifth Ave., New York 17, N. Y.
Cinema Television Ltd., Worsley Bridge Rd., London, S. E., 26, England
Clarkstan Corp., 11921 SW Pico Blvd., Los Angeles 64, Calif.
COLE, LTD., E. K., Electronics Div., Malmesbury, Wiltshire, England. ADV. PG. 28

NUCLEAR AND ALLIED PRODUCTS

Decade Instrument Co., P. O. Box 153, Caldwell, N. J.
Douglas Radio Labs., 176 Norfolk Ave., Boston 19, Mass.
El-Tronics, Inc., 2649 N. Howard St., Philadelphia 33, Pa.
GENERAL ELECTRIC CO., Apparatus Sales Div., Schenectady 5, N. Y. ADV. PGS. 2–5
General Radio Co., 275 Massachusetts Ave., Cambridge 39, Mass.
Measurement Engineering Ltd., Arnprior, Ontario, Canada
Nuclear Development Laboratory, P. O. Box 7034, Kansas City, Mo.
NUCLEAR INSTRUMENT & CHEMICAL CORP., 223 W. Erie St., Chicago 10, Ill. ADV. PG. Back Cover
Nuclear Measurements Corp., 2460 N. Arlington Ave., Indianapolis 18, Ind.
NUCLEAR RESEARCH CORP., 2563 Grays Ferry Ave., Philadelphia 46, Pa. ADV. PG. 97
NUCLEAR RESEARCH & DEVELOPMENT INC., 1094 Sutter Ave., St. Louis, Mo. ADV. PG. 103
NUCLEONIC CO. OF AMERICA, 497 Union St., Brooklyn 31, N. Y. ADV. PG. 112
Nucleonics & Radiological Developments Ltd., 77 King's Rd., London, S. W. 3, England
Ohmart Corp., The, 2347 Ferguson Ave., Cincinnati 38, Ohio
Patterson, Moos & Co., Inc., 32–36 47th Ave., Long Island City 1, N. Y.
PRECISION RADIATION INSTRUMENTS, 2235 S. La Brea Ave., Los Angeles 16, Calif. ADV. PG. 108
R-C SCIENTIFIC INSTRUMENT CO., 335 Culver Blvd., Playa Del Rey, Calif. ADV. PG. 129
Radiation Counter Labs., Inc., 1844 W. 21st St., Chicago 8, Ill.
RADIATION INSTRUMENT DEVELOPMENT LAB., 2337 W. 67th St., Chicago 36, Ill. ADV. PG. Inside Back Cover
RADIOACTIVE PRODUCTS, INC., 443 W. Congress St., Detroit 26, Mich. ADV. PG. 8
Raytheon Mfg. Corp., Equipment Sales Div., Waltham 54, Mass.
Resdel Engineering, 2351 Riverside Drive, Los Angeles 39, Calif.
Special Instrument Laboratory, Inc., 1003 Highland Ave., Knoxville, Tenn.
TECHNICAL ASSOCIATES, INC., 140 W. Providencia Ave., Burbank, Calif. ADV. PG. 130
TECHNICAL OPERATIONS, INC., 6 Schouler Court, Arlington 74, Mass. ADV. PG. 128
TRACERLAB, INC., 130 High Street, Boston 10, Mass. ADV. PG. 24
Twentieth Century Electronics, Ltd., Dunbar Works, Dunbar St., West Norwood, London, S. E. 27, England
VICTOREEN INSTRUMENT CO., 3800 Perkins Ave., Cleveland 14, Ohio. ADV. PG. Inside Front Cover
Wood Counter Laboratory, N., 5491 Blackstone, Chicago 15, Ill.

COUNTERS—Beta

ABLE SCIENTIFIC GLASS APPARATUS CO., 5041 W. Lake St., Chicago 44, Ill. ADV. PGS. 108, 131, 134
Airmec Laboratories, Ltd., High Wycombe, Buckinghamshire, England
Allied Radio Corp, 833 W. Jackson Blvd., Chicago 7, Ill.
American Instrument Co., Inc., 8030 Georgia Ave., Silver Spring, Md.
ANTON ELECTRONIC LABS., INC., 1226–38 Flushing Ave., Brooklyn 37, N. Y. ADV. PG. 136
ATOMIC INSTRUMENT CO., 84 Massachusetts Ave., Cambridge 39, Mass. ADV. PG. 23
Atomlab, Inc., 489 Fifth Ave., New York 17, N. Y.
Berkeley Scientific Div. of Beckman Instruments, 2200 Wright Ave., Richmond, Calif.
Cinema-Television Ltd., Worsley Bridge Rd., London, S. E. 26, England
COLE, LTD., E. K., Electronics Div., Malmesbury, Wiltshire, England. ADV. PG. 28
Decade Instrument Co., P. O. Box 153, Caldwell, N. J.
Detectron Co., 5631 Cahuenga Blvd., North Hollywood, Calif.
Douglas Radio Labs., 176 Norfolk Ave., Boston 19, Mass.
Eck & Krebs, Inc., 27–09 40th Ave., Long Island City 1, N. Y.
Electronic Products Co., 111 E. Third St., Mount Vernon, N. Y.
El-Tronics, Inc., 2649 N. Howard St., Philadelphia 33, Pa.
GENERAL ELECTRIC CO., Apparatus Sales Div., Schenectady 5, N. Y. ADV. PGS. 2–5
General Radio Co., 275 Massachusetts Ave., Cambridge 39, Mass.
Georator Corp., 1820 N. Nash St., Arlington, Va.
Measurement Engineering Ltd., Arnprior, Ontario, Canada
Nuclear Development Laboratory, P. O. Box 7034, Kansas City, Mo.
NUCLEAR INSTRUMENT & CHEMICAL CORP., 223 W. Erie St., Chicago 10, Ill. ADV. PG. Back Cover
Nuclear Measurements Corp., 2460 N. Arlington Ave., Indianapolis 18, Ind.
NUCLEAR RESEARCH CORP., 2563 Grays Ferry Ave., Philadelphia 46, Pa. ADV. PG. 97
NUCLEAR RESEARCH & DEVELOPMENT INC., 1094 Sutter Ave., St. Louis, Mo. ADV. PG. 103
NUCLEONIC CO. OF AMERICA, 497 Union St., Brooklyn 31, N. Y. ADV. PG. 112
Nucleonics & Radiological Developments Ltd., 77 King's Rd., London, S. W. 3, England
Ohmart Corp., The, 2347 Ferguson Ave., Cincinnati 38, Ohio
Patterson, Moos & Co., Inc., 32–36 47th Ave., Long Island City 1, N. Y.
PRECISION RADIATION INSTRUMENTS, 2235 S. La Brea Ave., Los Angeles 16, Calif. ADV. PG. 108
R-C SCIENTIFIC INSTRUMENT CO., 335 Culver Blvd., Playa Del Rey, Calif. ADV. PG. 129
Radiation Counter Labs., Inc., 1844 W. 21st St., Chicago 8, Ill.
RADIATION INSTRUMENT DEVELOPMENT LAB., 2337 W. 67th St., Chicago 36, Ill. ADV. PG. Inside Back Cover
RADIOACTIVE PRODUCTS, INC., 443 W. Congress St., Detroit 26, Mich. ADV. PG. 8
Raytheon Mfg. Corp., Equipment Sales Div., Waltham 54, Mass.
Resdel Engineering, 2351 Riverside Drive, Los Angeles 39, Calif.
Special Instrument Laboratory, Inc., 1003 Highland Ave., Knoxville, Tenn.
Sylvania Electric Products, Inc., 1740 Broadway, New York 19, N. Y.
TECHNICAL ASSOCIATES, INC., 140 W. Providencia Ave., Burbank, Calif. ADV. PG. 130
TECHNICAL OPERATIONS, INC., 6 Schouler Court, Arlington 74, Mass. ADV. PG. 128
TRACERLAB, INC., 130 High Street, Boston 10, Mass. ADV. PG. 24
Twentieth Century Electronics, Ltd., Dunbar Works, Dunbar St., West Norwood, London, S. E. 27, England
VICTOREEN INSTRUMENT CO., 3800 Perkins Ave., Cleveland 14, Ohio. ADV. PG. Inside Front Cover
Wood Counter Laboratory, N., 5491 Blackstone, Chicago 15, Ill.

COUNTERS—Crystal Conduction

Decade Instrument Co., P. O. Box 153, Caldwell, N. J.
GENERAL ELECTRIC CO., Apparatus Sales Div., Schenectady 5, N. Y. ADV. PGS. 2–5
NUCLEAR RESEARCH CORP., 2563 Grays Ferry Ave., Philadelphia 46, Pa. ADV. PG. 97
Patterson, Moos & Co., 32–36 47th Ave., Long Island City 1, N. Y.
Wood Counter Laboratory, N., 5491 Blackstone, Chicago 15, Ill.

COUNTERS—Flow

ATOMIC INSTRUMENT CO., 84 Massachusetts Ave., Cambridge 39, Mass. ADV. PG. 23
Atomlab, Inc., 489 Fifth Ave., New York 17, N. Y.
Bristol Co., The, Waterbury 20, Conn.
Brooks Rotameter Co., Box A–1347, Lansdale, Pa.
Builders-Providence, Inc., P. O. Box 1342, Providence 1, R. I.
COLE, LTD., E. K., Electronics Div., Malmesbury, Wiltshire, England. ADV. PG. 28
Decade Instrument Co., P. O. Box 153, Caldwell, N. J.
El-Tronics, Inc., 2649 N. Howard St., Philadelphia 33, Pa.
Fischer & Porter Co., 50 County Line Rd., Hatboro, Pa.
Foxboro Co., 38 Neponset Ave., Foxboro, Mass.
ISOTOPE SPECIALTIES CO., 3816 San Fernando Rd., Glendale, Calif. ADV. PG. 94
Nuclear Development Laboratory, P. O. Box 7034, Kansas City, Mo.
Nuclear Measurements Corp., 2460 N. Arlington Ave., Indianapolis 18, Ind.
NUCLEONIC CO. OF AMERICA, 497 Union St., Brooklyn 31, N. Y. ADV. PG. 112
Patterson, Moos & Co., Inc., 32–36 47th Ave., Long Island City 1, N. Y.
Radiation Counter Labs., Inc., 1844 W. 21st St., Chicago 8, Ill.
RADIATION INSTRUMENT DEVELOPMENT LAB., 2337 W. 67th St., Chicago 36, Ill. ADV. PG. Inside Back Cover
Research Equipment & Service, 6054 Woodlawn Ave., Chicago 37, Ill.
TECHNICAL ASSOCIATES, INC., 140 W. Providencia Ave., Burbank, Calif. ADV. PG. 130
TECHNICAL OPERATIONS, INC., 6 Schouler Court, Arlington 74, Mass. ADV. PG. 128
TRACERLAB, INC., 130 High St., Boston 10, Mass. ADV. PG. 24
Twentieth Century Electronics, Ltd., Dunbar Works, Dunbar St., West Norwood, London, S. E. 27, England
Wood Counter Laboratory, N., 5491 Blackstone, Chicago 15, Ill.

COUNTERS—Gamma

ABLE SCIENTIFIC GLASS APPARATUS CO., 5041 W. Lake St., Chicago 44, Ill. ADV. PGS. 108, 131, 134
Airmec Laboratories, Ltd., High Wycombe, Buckinghamshire, England
Allied Radio Corp., 833 W. Jackson Blvd., Chicago 7, Ill.
American Instrument Co., Inc., 8030 Georgia Ave., Silver Spring, Md.
ANTON ELECTRONIC LABS., INC., 1226–38 Flushing Ave., Brooklyn 37, N. Y. ADV. PG. 136
ATOMIC INSTRUMENT CO., 84 Massachusetts Ave., Cambridge 39, Mass. ADV. PG. 23
Atomlab, Inc., 489 Fifth Ave., New York 17, N. Y.
Beckman Instruments, Inc., 820 Mission St., South Pasadena 183, Calif.
Berkeley Scientific Div. of Beckman Instruments, 2200 Wright Ave., Richmond, Calif.
Cinema-Television Ltd., Worsley Bridge Rd., London S. E., 26, England
COLE, LTD., E. K., Electronics Div., Malmesbury, Wiltshire, England. ADV. PG. 28
Decade Instrument Co., P. O. Box 153, Caldwell, N. J.
Detectron Co., 5631 Cahuenga Blvd., North Hollywood, Calif.
Douglas Radio Labs., 176 Norfolk Ave., Boston 19, Mass.
Electronic Products Co., 111 E. Third St., Mount Vernon, N. Y.
El-Tronics, Inc., 2649 N. Howard St., Philadelphia 33, Pa.
GENERAL ELECTRIC CO., Apparatus Sales Div., Schenectady 5, N. Y. ADV. PGS. 2–5
General Radio Co., 275 Massachusetts Ave., Cambridge 39, Mass.
Georator Corp., 1820 N. Nash St., Arlington, Va.
Leighton Labs., H. W., 26 Herman St., Glen Ridge, N. J.
Macdonald Co., Inc., W. S., 33 University Rd., Cambridge 38, Mass.
Measurement Engineering Ltd., Arnprior, Ontario, Canada
Menlo Research Laboratory, Menlo Park, Calif.
Nuclear Development Laboratory, P. O. Box 7034, Kansas City, Mo.
NUCLEAR INSTRUMENT & CHEMICAL CORP., 223 W. Erie St., Chicago 10, Ill. ADV. PG. Back Cover
Nuclear Measurements Corp., 2460 N. Arlington Ave., Indianapolis 18, Ind.
NUCLEAR RESEARCH CORP., 2563 Grays Ferry Ave., Philadelphia 46, Pa. ADV. PG. 97
NUCLEAR RESEARCH & DEVELOPMENT INC., 1094 Sutter Ave., St. Louis, Mo. ADV. PG. 103
NUCLEONIC CO. OF AMERICA, 497 Union St., Brooklyn 31, N. Y. ADV. PG. 112
Nucleonics & Radiological Developments Ltd., 77 King's Rd., London, S. W. 3, England
Ohmart Corp., The, 2347 Ferguson Ave., Cincinnati 38, Ohio
Patterson, Moos & Co., Inc., 32–36 47th Ave., Long Island City 1, N. Y.
PRECISION RADIATION INSTRUMENTS, 2235 S. La Brea Ave., Los Angeles 16, Calif. ADV. PG. 108
R-C SCIENTIFIC INSTRUMENT CO., 335 Culver Blvd., Playa Del Rey, Calif. ADV. PG. 129
Radiation Counter Labs., Inc., 1844 W. 21st St., Chicago 8, Ill.
RADIATION INSTRUMENT DEVELOPMENT LAB., 2337 W. 67th St., Chicago 36, Ill. ADV. PG. Inside Back Cover
Resdel Engineering, 2351 Riverside Drive, Los Angeles 39, Calif.
Special Instrument Laboratory, Inc., 1003 Highland Ave., Knoxville, Tenn.
Sylvania Electric Products, Inc., 1740 Broadway, New York 19, N. Y.
TECHNICAL ASSOCIATES, INC., 140 W. Providencia Ave., Burbank, Calif. ADV. PG. 130
TECHNICAL OPERATIONS, INC., 6 Schouler Court, Arlington 74, Mass. ADV. PG. 128
TRACERLAB, INC., 130 High St., Boston 10, Mass. ADV. PG. 24
Twentieth Century Electronics, Ltd., Dunbar Works, Dunbar St., West Norwood, London, S. E. 27, England
VICTOREEN INSTRUMENT Co., 3800 Perkins Ave., Cleveland 14, Ohio. ADV PG. Inside Front Cover
Welch Allyn, Inc., Skaneateles Falls, N. Y.
Western Radiation Lab., 1107 W 24th St., Los Angeles 27, Calif.
Wood Counter Laboratory, N 5491 Blackstone, Chicago 15, Ill.

COUNTERS—High Temperature

ANTON ELECTRONIC LABS., INC., 1226–38 Flushing Ave., Brooklyn 37, N. Y ADV. PG. 136
Decade Instrument Co., P. O. Box 153, Caldwell, N. J.
GENERAL ELECTRIC CO., Apparatus Sales Div., Schenectady 5, N. Y. ADV. PGS. 2–5

Nuclear Development Laboratory, P. O. Box 7034, Kansas City, Mo.
Radiation Counter Labs., Inc., 1844 W. 21st St., Chicago 8, Ill.

COUNTERS—Methane Flow Alpha

Atomlab, Inc., 489 Fifth Ave., New York 17, N. Y.
COLE, LTD., E. K., Electronics Div., Malmesbury, Wiltshire, England. ADV. PG. 28
Decade Instrument Co., P. O. Box 153, Caldwell, N. J.
El-Tronics, Inc., 2649 N. Howard St., Philadelphia 33, Pa.
NUCLEAR INSTRUMENT & CHEMICAL CORP., 223 W. Erie St., Chicago 10, Ill. ADV. PG. Back Cover
Nuclear Measurements Corp., 2460 N. Arlington Ave., Indianapolis 18, Ind.
Radiation Counter Labs., Inc., 1844 W. 21st St., Chicago 8, Ill.
RADIATION INSTRUMENT DEVELOPMENT LAB., 2337 W. 67th St., Chicago 36, Ill. ADV. PG. Inside Back Cover
TECHNICAL ASSOCIATES, INC., 140 W. Providencia Ave., Burbank, Calif. ADV. PG. 130
TECHNICAL OPERATIONS, INC., 6 Schouler Court, Arlington 74, Mass. ADV. PG. 128
TRACERLAB, INC., 130 High St., Boston 10, Mass. ADV. PG. 24
Wood Counter Laboratory, N., 5491 Blackstone, Chicago 15, Ill.

COUNTERS—Neutron

ANTON ELECTRONIC LABS., INC., 1226-38 Flushing Ave., Brooklyn 37, N. Y. ADV. PG. 136
Atomlab, Inc., 489 Fifth Ave., New York 17, N. Y.
Cole Instrument Co., 1320 S. Grand Ave., Los Angeles 15, Calif.
Decade Instrument Co., P. O. Box 153, Caldwell, N. J.
El-Tronics, Inc., 2649 N. Howard St., Philadelphia 33, Pa.
GENERAL ELECTRIC CO., Apparatus Sales Div., Schenectady 5, N. Y. ADV. PGS. 2–5
Georator Corp., 1820 N. Nash St., Arlington, Va.
Measurement Engineering Ltd., Arnprior, Ontario, Canada
NUCLEAR INSTRUMENT & CHEMICAL CORP., 223 W. Erie St., Chicago 10, Ill. ADV. PG. Back Cover
NUCLEAR RESEARCH & DEVELOPMENT INC., 1094 Sutter Ave., St. Louis, Mo. ADV. PG. 103
Ohmart Corp., The, 2347 Ferguson Ave., Cincinnati 38, Ohio
Patterson, Moos & Co., Inc., 32–36 47th Ave., Long Island City 1, N. Y.
R-C SCIENTIFIC INSTRUMENT CO., 335 Culver Blvd., Playa Del Rey, Calif. ADV. PG. 129
Radiation Counter Labs., Inc., 1844 W. 21st St., Chicago 8, Ill.
RADIOACTIVE PRODUCTS, INC., 443 W. Congress St., Detroit, Mich. ADV. PG. 8
Resdel Engineering, 2351 Riverside Drive, Los Angeles 39, Calif.
TECHNICAL ASSOCIATES, INC., 140 W. Providencia Ave., Burbank, Calif. ADV. PG. 130
Twentieth Century Electronics, Ltd., Dunbar Works, Dunbar St., West Norwood, London, S. E. 27, England
Wood Counter Laboratory, N., 5491 Blackstone, Chicago 15, Ill.

COUNTERS—Probing, Medical

ANTON ELECTRONIC LABS., INC., 1226-38 Flushing Ave., Brooklyn 37, N. Y. ADV. PG. 136
Leighton Labs., H. W., 26 Herman St., Glen Ridge, N. J.

COUNTERS—Proportional

Air Associates, Inc., Teterboro, N. J.
ANTON ELECTRONIC LABS., INC., 1226-38 Flushing Ave., Brooklyn 37, N. Y. ADV. PG. 136
Atomlab, Inc., 489 Fifth Ave., New York 17, N. Y.
COLE, LTD., E. K., Electronics Div., Malmesbury, Wiltshire, England. ADV. PG. 28
Decade Instrument Co., P. O. Box 153, Caldwell, N. J.
Douglas Radio Labs., 176 Norfolk Ave., Boston 19, Mass.
El-Tronics, Inc., 2649 N. Howard St., Philadelphia 33, Pa.
GENERAL ELECTRIC CO., Apparatus Sales Div., Schenectady 5, N. Y. ADV. PGS. 2–5
North American Philips Co., Inc., 100 E. 42nd St., New York 17, N. Y.
Nuclear Development Laboratory, P. O. Box 7034, Kansas City, Mo.
NUCLEAR INSTRUMENT & CHEMICAL CORP., 223 W. Erie St., Chicago 10, Ill. ADV. PG. Back Cover
Nuclear Measurements Corp., 2460 N. Arlington Ave., Indianapolis 18, Ind.
Nucleonics & Radiological Developments Ltd., 77 King's Rd., London, S. W. 3, England
Radiation Counter Labs., Inc., 1844 W. 21st St., Chicago 8, Ill.
RADIATION INSTRUMENT DEVELOPMENT LAB., 2337 W. 67th St., Chicago 36, Ill. ADV. PG. Inside Back Cover
Resdel Engineering, 2351 Riverside Drive, Los Angeles 39, Calif.
TECHNICAL ASSOCIATES INC., 140 W. Providencia Ave., Burbank, Calif. ADV. PG. 130
TECHNICAL OPERATIONS, INC., 6 Schouler Court, Arlington 74, Mass. ADV. PG. 128
TRACERLAB, INC., 130 High St., Boston 10, Mass. ADV. PG. 24
Twentieth Century Electronics, Ltd., Dunbar Works, Dunbar St., West Norwood, London, S. E. 27, England
VICTOREEN INSTRUMENT CO., 3800 Perkins Ave., Cleveland 14, Ohio. ADV. PG. Inside Front Cover
Wood Counter Laboratory, N., 5491 Blackstone, Chicago 15, Ill.

COUNTERS—Radiation

Airmec Laboratories, Ltd., High Wycombe, Buckinghamshire, England
ANTON ELECTRONIC LABS., INC., 1226-38 Flushing Ave., Brooklyn 37, N. Y. ADV. PG. 136
ATOMIC INSTRUMENT CO., 84 Massachusetts Ave., Cambridge 39, Mass. ADV. PG. 23
Atomlab, Inc., 489 Fifth Ave., New York 17, N. Y.
Beckman Instruments, Inc., 820 Mission St., South Pasadena 183, Calif.
Berkeley Scientific Div. of Beckman Instruments, 2200 Wright Ave., Richmond, Calif.
COLE, LTD., E. K., Electronics Div., Malmesbury, Wiltshire, England. ADV. PG. 28
Decade Instrument Co., P. O. Box 153, Caldwell, N. J.
Detectron Co., 5631 Cahuenga Blvd., North Hollywood, Calif.
Douglas Radio Labs., 176 Norfolk Ave., Boston 19, Mass.
Electronic Products Co., 111 E. Third St., Mount Vernon, N. Y.
El-Tronics, Inc., 2649 N. Howard St., Philadelphia 33, Pa.
GENERAL ELECTRIC CO., Apparatus Sales Div., Schenectady 5, N. Y. ADV. PGS. 2–5
General Radio Co., 275 Massachusetts Ave., Cambridge 39, Mass.
Georator Corp., 1820 N. Nash St., Arlington, Va.
Measurement Engineering Ltd., Arnprior, Ontario, Canada
Menlo Research Laboratory, Menlo Park, Calif.
New London Instrument Co., P. O. Box 189, New London, Conn.
Nuclear Development Laboratory, P. O. Box 7034, Kansas City, Mo.
NUCLEAR INSTRUMENT & CHEMICAL CORP., 223 W. Erie St., Chicago 10, Ill. ADV. PG. Back Cover
Nuclear Measurements Corp., 2460 N. Arlington Ave., Indianapolis 18, Ind.
NUCLEAR RESEARCH CORP., 2563 Grays Ferry Ave., Philadelphia 46, Pa. ADV. PG. 97
NUCLEAR RESEARCH & DEVELOPMENT INC., 1094 Sutter Ave., St. Louis, Mo. ADV. PG. 103
NUCLEONIC CO. OF AMERICA, 497 Union St., Brooklyn 31, N. Y. ADV. PG. 112
Nucleonics & Radiological Developments Ltd., 77 King's Rd., London, S. W. 3, England
Ohmart Corp., The, 2347 Ferguson Ave., Cincinnati 38, Ohio
Patterson, Moos & Co., Inc., 32–36 47th Ave., Long Island City 1, N. Y.
PRECISION RADIATION INSTRUMENTS, 2235 S. LaBrea Ave., Los Angeles 16, Calif. ADV. PG. 108
R-C SCIENTIFIC INSTRUMENT CO., 335 Culver Blvd., Playa Del Rey, Calif. ADV. PG. 129
Radiation Counter Labs., Inc., 1844 W. 21st St., Chicago 8, Ill.
RADIATION INSTRUMENT DEVELOPMENT LAB., 2337 W. 67th St., Chicago 36, Ill. ADV. PG. Inside Back Cover
RADIO CORP. OF AMERICA, RCA VICTOR DIV., ENGINEERING RODUCTS DEPT., Front & Cooper Sts., Camden, N. J. ADV. PG. 13
Resdel Engineering, 2351 Riverside Drive, Los Angeles 39, Calif.
Special Instruments Laboratory, Inc., 1003 Highland Ave., Knoxville, Tenn.
Streater-Amet Co., 4101 Ravenswood Ave., Chicago 13, Ill.
TECHNICAL ASSOCIATES, INC., 140 W. Providencia Ave., Burbank, Calif. ADV. PG. 130
TECHNICAL OPERATIONS, INC., 6 Schouler Court, Arlington 74, Mass. ADV. PG. 128
TRACERLAB, INC., 130 High St., Boston 10, Mass. ADV. PG. 24
Twentieth Century Electronics, Ltd., Dunbar Works, Dunbar St., West Norwood, London, S. E. 27, England
VICTOREEN INSTRUMENT CO., 3800 Perkins Ave., Cleveland 14, Ohio. ADV. PG. Inside Front Cover
WATERS, INC., ROBERT A., 4 Gordon St., Waltham 54, Mass. ADV. PG. 115
Western Radiation Lab., 1107 W. 24th St., Los Angeles 27, Calif.
Wood Counter Laboratory, N., 5491 Blackstone, Chicago 15, Ill.

COUNTERS—Scintillation

ATOMIC INSTRUMENT CO., 84 Massachusetts Ave., Cambridge 39, Mass. ADV. PG. 23
Atomlab, Inc., 489 Fifth Ave., New York 17, N. Y.
Berkeley Scientific Div. of Beckman Instruments, 2200 Wright Ave., Richmond, Calif.
COLE, LTD., E. K., Electronics Div., Malmesbury, Wiltshire, England. ADV. PG. 28
Decade Instrument Co., P. O. Box 153, Caldwell, N. J.
Detectron Co., 5631 Cahuenga Blvd., North Hollywood, Calif.
Douglas Radio Labs., 176 Norfolk Ave., Boston 19, Mass.
El-Tronics, Inc., 2649 N. Howard St., Philadelphia 33, Pa.
GENERAL ELECTRIC CO., Apparatus Sales Div., Schenectady 5, N. Y. ADV. PGS. 2–5
ISOTOPE SPECIALTIES CO., 3816 San Fernando Rd., Glendale, Calif. ADV. PG. 94
Macdonald Co., Inc., W. S., 33 University Rd. Cambridge 38, Mass.
Measurement Engineering Ltd., Arnprior, Ontario, Canada
NATIONAL RADIAC, INC., 10 Crawford St., Newark 2, N. J. ADV. PG. 126
NUCLEAR INSTRUMENT & CHEMICAL CORP., 223 W. Erie St., Chicago 10, Ill. ADV. PG. Back Cover
Nuclear Measurements Corp., 2460 N. Arlington Ave., Indianapolis 18, Ind.
NUCLEAR RESEARCH CORP., 2563 Grays Ferry Ave., Philadelphia 46, Pa. ADV. PG. 97
NUCLEAR RESEARCH & DEVELOPMENT INC., 1094 Sutter Ave., St. Louis, Mo. ADV. PG. 103
Patterson, Moos & Co., Inc., 32–36 47th Ave., Long Island City 1, N. Y.
PRECISION RADIATION INSTRUMENTS, 2235 S. LaBrea Ave., Los Angeles 16, Calif. ADV. PG. 108
R-C SCIENTIFIC INSTRUMENT CO., 335 Culver Blvd., Playa Del Rey, Calif. ADV. PG. 129
Radiation Counter Labs., Inc., 1844 W. 21st St., Chicago 8, Ill.
RADIATION INSTRUMENT DEVELOPMENT LAB., 2337 W. 67th St., Chicago 36, Ill. ADV. PG. Inside Back Cover
RADIOACTIVE PRODUCTS, INC., 443 W. Congress St., Detroit, Mich. ADV. PG. 8
RADIO CORP. OF AMERICA, RCA VICTOR DIV., ENGINEERING PRODUCTS DEPT., Front & Cooper Sts., Camden N. J. ADV. PG. 13
Resdel Engineering, 2351 Riverside Drive, Los Angeles 39, Calif.
Standard Electronics Research Corp., 2 East End Ave., New York 21, N. Y.
TECHNICAL ASSOCIATES, INC., 140 W. Providencia Ave., Burbank, Calif. ADV. PG. 130
TECHNICAL OPERATIONS, INC., 6 Schouler Court, Arlington 74, Mass. ADV. PG. 128
TRACERLAB, INC., 130 High St., Boston 10, Mass. ADV. PG. 24
VICTOREEN INSTRUMENT CO., 3800 Perkins Ave., Cleveland 14, Ohio. ADV. PG. Inside Front Cover
Wood Counter Laboratory, N., 5491 Blackstone, Chicago 15, Ill.

COUNTERS—X-Ray

Allied Radio Corp., 833 W. Jackson Blvd., Chicago 7, Ill.
ANTON ELECTRONIC LABS., INC., 1226-38 Flushing Ave., Brooklyn 37, N. Y. ADV. PG. 136
Atomlab, Inc., 489 Fifth Ave., New York 17, N. Y.
COLE, LTD., E. K., Electronics Div., Malmesbury, Wiltshire, England. ADV. PG. 28
Decade Instrument Co., P. O. Box 153, Caldwell, N. J.
Douglas Radio Labs., 176 Norfolk Ave., Boston 19, Mass.
El-Tronics, Inc., 2649 N. Howard St., Philadelphia 33, Pa.
Emerson-Sack-Warner Corp., 150 Dorchester Ave., South Boston 23, Mass.
Fleming Radio Ltd., 18–20 Laystall St., London, E. C. 1, England
GENERAL ELECTRIC CO., Apparatus Sales Div., Schenectady 5, N. Y. ADV. PGS. 2–5
Menlo Research Laboratory, Menlo Park, Calif.
Mullard Overseas Ltd., Century House, Shaftesbury Ave., London W. C. 2, England
North American Philips Co., Inc., 100 E. 42nd St., New York 17, N. Y.
Nuclear Development Laboratory, P. O. Box 7034, Kansas City, Mo.
NUCLEAR INSTRUMENT & CHEMICAL CORP., 223 W. Erie St., Chicago 10, Ill. ADV. PG. Back Cover
NUCLEAR RESEARCH CORP., 2563 Grays Ferry Ave., Philadelphia 46, Pa. ADV. PG. 97
NUCLEAR RESEARCH & DEVELOPMENT INC., 1094 Sutter Ave., St. Louis, Mo. ADV. PG. 103

Nucleonics & Radiological Developments Ltd., 77 King's Rd., London, S. W. 3, England
Ohmart Corp., The, 2347 Ferguson Ave., Cincinnati 38, Ohio
PRECISION RADIATION INSTRUMENTS, 2235 S. LaBrea Ave., Los Angeles 16, Calif. ADV. PG. 108
R-C SCIENTIFIC INSTRUMENT CO., 335 Culver Blvd., Playa Dey Rey, Calif. ADV. PG. 129
Radiation Counter Labs., Inc., 1844 W. 21st St., Chicago 8, Ill.
Standard Electronics Research Corp., 2 East End Ave., New York 21, N. Y.
TRACERLAB, INC., 130 High St., Boston 10, Mass. ADV. PG. 24
Twentieth Century Electronics, Ltd., Dunbar Works, Dunbar St., West Norwood, London, S. E. 27, England
Voeder-Root, Inc., 20 Sargeant St., Hartford 2, Conn.
VICTOREEN INSTRUMENT CO., 3800 Perkins Ave., Cleveland 14, Ohio. ADV. PG. Inside Front Cover
Western Radiation Lab., 1107 W. 24th St., Los Angeles 27, Calif.
Wood Counter Laboratory, N., 5491 Blackstone, Chicago 15, Ill.

CRYSTALS—Scintillation

ATOMIC INSTRUMENT CO., 84 Massachusetts Ave., Cambridge 39, Mass. ADV. PG. 23
COLE, LTD., E. K., Electronics Div., Malmesbury, Wiltshire, England. ADV. PG. 28
El-Tronics., Inc., 2649 N. Howard St., Philadelphia 33, Pa.
GENERAL ELECTRIC CO., Apparatus Sales Div., Schenectady 5, N. Y. ADV. PGS. 2–5
Harshaw Scientific, Div. of Harshaw Chemical Co., 1945 E. 97th St., Cleveland 6, Ohio
Jasonola Chemical Corp., 1085 Myrtle Ave., Brooklyn 6, N. Y.
Macdonald Co., Inc., W. S., 33 University Rd., Cambridge 38, Mass.
NATIONAL RADIAC, INC., 10 Crawford St., Newark 2, N. J. ADV. PG. 126
NUCLEAR RESEARCH CORP., 2563 Grays Ferry Ave., Philadelphia 46, Pa. ADV. PG. 97
NUCLEAR RESEARCH & DEVELOPMENT INC., 1094 Sutter Ave., St. Louis, Mo. ADV. PG. 103
R-C SCIENTIFIC INSTRUMENT CO., 335 Culver Blvd., Playa Del Rey, Calif. ADV. PG. 129
Reilly Tar & Chemical Corp., 1615 Merchants Bank Bldg., 11 S. Meridan St., Indianapolis, Ind.
TECHNICAL ASSOCIATES, INC., 140 W. Providencia Ave., Burbank, Calif. ADV. PG. 130
TRACERLAB, INC., 130 High St., Boston 10, Mass. ADV. PG. 24
Wakefield Industries, Inc., 5108 Grove St., Skokie, Ill.
Wood Counter Laboratory, N., 5491 Blackstone, Chicago 15, Ill.

DECADE BOXES—Capacitance

Allied Radio Corp., 833 W. Jackson Blvd., Chicago 7, Ill.
CAMBRIDGE INSTRUMENT CO., INC., 3786 Grand Central Terminal, New York 17, N. Y. ADV. PG. 123
Condenser Products Co., 7517 N. Clark St., Chicago 26, Ill.
Cornell-Dubilier Electric Corp., South Plainfield, N. J.
Electronic Instrument Co., Inc., 276 Newport St., Brooklyn 12, N. Y.
Elrodynne Co., 32 Oliver St., Boston, Mass.
Freed Transformer Co., Inc., 1736 Weirfield St., Brooklyn 27, N. Y.
General Radio Co., 275 Massachusetts Ave., Cambridge 39, Mass.
Industrial Instruments, Inc., 89 Commerce Rd., Cedar Grove, N. J.
Leeds & Northrup Co., 4970 Stenton Ave., Philadelphia 44, Pa.
Leland Instruments Ltd., 22–23 Millbank, London, S. W. 1, England
Muirhead & Co., Ltd., Beckenham, Kent, England
Telectro Industries Corp., 35–18 37th St., Long Island City 1, N. Y.
Welch Scientific Co., W. M., 1515 Sedgwick St., Chicago 10, Ill.
Western Sound & Electric Labs., Inc., 805 S. Fifth St., Milwaukee 4, Wis.
Winslow Co., Inc., 9 Liberty St., Newark, N. J.

DECADE BOXES—Inductance

Allied Radio Corp., 833 W. Jackson Blvd., Chicago 7, Ill.
CAMBRIDGE INSTRUMENT CO., INC., 3786 Grand Central Terminal, New York 17, N. Y. ADV. PG. 123
Freed Transformer Co., Inc., 1736 Weirfield St., Brooklyn 27, N. Y.
General Radio Co., 275 Massachusetts Ave., Cambridge 39, Mass.
Hycor Co., Inc., 11423 Vanowen St., North Hollywood, Calif.
Leeds & Northrup Co., 4970 Stenton Ave., Philadelphia 44, Pa.
Leland Instruments Ltd., 22–23 Millbank, London, S. W. 1, England
Lenkurt Electric Co., Inc., 1113 County Road, San Carlos, Calif.
Muirhead & Co., Ltd., Beckenham, Kent, England
Western Sound & Electric Labs., Inc., 805 S. Fifth St., Milwaukee 4, Wis.
Winslow Co., Inc., 9 Liberty St., Newark, N. J.

DECADE BOXES—Resistance

Allied Radio Corp., 833 W. Jackson Blvd., Chicago 7, Ill.
Baldwin Instrument Co., Ltd., Brooklands Works, Dartford, Kent, England
Brown Electro-Measurement Corp., 4637 SE Hawthorne Blvd., Portland 15, Ore.
CAMBRIDGE INSTRUMENT CO., INC., 3786 Grand Central Terminal, New York 17, N. Y. ADV. PG. 123
Cinema Engineering Co., 1510 W. Verdugo Ave., Burbank, Calif.
Clarostat Mfg. Co., Inc., Dover, New Hampshire
Cole Instrument Co., 1320 S. Grand Ave., Los Angeles 15, Calif.
Daven Co., 191 Central Ave., Newark 4, N. J.
Elrodynne Co., 32 Oliver St., Boston, Mass.
Electronic Instrument Co., Inc., 276 Newport St., Brooklyn 12, N. Y.
General Radio Co., 275 Massachusetts Ave., Cambridge 39, Mass.
Heath Co., Benton Harbor, Mich.
HELIPOT CORP., 916 Meridian Ave., South Pasadena, Calif. ADV. PG. 27
Hycor Co., Inc., 11423 Vanowen St., North Hollywood, Calif.
Industrial Instruments, Inc., 89 Commerce Rd., Cedar Grove, N. J.
Instrument Resisters Co., 1036 Commerce Ave., Union, N. J.
Leeds & Northrup Co., 4970 Stenton Ave., Philadelphia 44, Pa.
Leland Instruments Ltd., 22–23 Millbank, London, S. W. 1, England
Muirhead & Co., Ltd., Beckenham, Kent, England
Ohmite Mfg. Co., 4835 W. Flournoy St., Chicago 44, Ill.
Rubicon Co., Ridge Ave. at 35th St., Philadelphia 32, Pa.
Shallcross Mfg. Co., 10 Jackson Ave., Collingdale, Pa.
Sticht, Inc., Herman H., 27 Park Place, New York 7, N. Y.
Tech Laboratories, Inc., Bergen & Edsall Blvds., Palisades Park, N. J.
Technology Instrument Corp., 531 Main St., Acton, Mass.
VICTOREEN INSTRUMENT CO., 3800 Perkins Ave., Cleveland 14, Ohio. ADV. PG. Inside Front Cover
Welch Scientific Co., W. M., 1515 Sedgwick St., Chicago 10, Ill.
Western Sound & Electric Labs., Inc., 805 S. Fifth St., Milwaukee 4, Wis.
Winslow Co., Inc., 9 Liberty St., Newark, N. J.

DECONTAMINANTS

Alrose Chemical Co., Box 1294, Providence, R. I.
Atomlab, Inc., 489 Fifth Ave., New York, N. Y.
BERSWORTH CHEMICAL CO., 875 Waverly St., Framingham, Mass. ADV. PG. 129
Passaic Analytical Labs., Inc., 228 Aycrigg Ave., Passaic, N. J.
Rohm & Haas Co., Washington Square, Philadelphia 5, Pa.

DEHUMIDIFIERS

Allied Chemical & Dye Corp., Solvay Process Div., 61 Broadway, New York 6, N. Y.
Carrier Corp., 300 S. Geddes St., Syracuse 1, N. Y.
Claraga Fan Co., 719 Porter St., Kalamazoo, Mich.
Colloid Equipment Co., Inc., 50 Church St., New York 7, N. Y.
Pittsburgh Lectrodryer Corp., P. O. Box 1766, Pittsburgh, Pa.
RADIOACTIVE PRODUCTS, INC., 443 W. Congress St., Detroit, Mich. ADV. PG. 8
Remington Air Conditioning Corp., Willoy St., Auburn, N. Y.
Western Blower Co., 1800 Airport Way, Seattle 66, Wash.

DEMAGNETIZERS

Bogue Electric Mfg. Co., 52 Iowa Ave., Paterson 3, N. J.
GENERAL ELECTRIC CO., Apparatus Sales Div., Schenectady 5, N. Y. ADV. PGS. 2–5
Magnaflux Corp., 5900 Northwest Highway, Chicago 31, Ill.
Martindale Electric Co., 1375 Hird Ave., Cleveland 7, Ohio
Minnesota Electronics Corp., 47 W. Water St., St. Paul 1, Minn.

DEMODULATORS—Radiation

Inst, Inc., 8655 S. Main St., Los Angeles 3, Calif.

DENSITOMETERS

American Instrument Co., Inc., 8030 Georgia Ave., Silver Spring, Md.
American Scientific Co., P. O. Box 1, Highbridge Station, New York 52, N. Y.
Applied Research Labs., 4336 San Fernando Rd., Glendale 4, Calif.
Audio Instrument Co., 133 W. 14th St., New York 11, N. Y.
Baldwin Instrument Co., Ltd., Brooklands Works, Dartford, Kent, England.
Bausch & Lomb Optical Co., 630 St. Paul St., Rochester 2, N. Y.
Bristol Co., The, Waterbury 20, Conn.
Eastman Kodak Co., Rochester 4, N. Y.
Electronic Control Corp., 1573 E. Forest St., Detroit 7, Mich.
Falk & Co., Ltd., M., 5 Victoria St., London, S. W. 1, England
Goertner Scientific Corp., 1237 Wrightwood Ave., Chicago, Ill.
Hogan Laboratories, Inc., 155 Perry St., New York 14, N. Y.
Jarrell-Ash Co., 165 Newberry St., Boston 16, Mass.
National Spectrographic Labs., Inc., 6300 Euclid Ave., Cleveland 3, Ohio
Photovolt Corp., 95 Madison Ave., New York 16, N. Y.
Standard Electronics Research Corp., 2 East End Ave., New York 21, N. Y.
Welch Scientific Co., W. M., 1515 Sedgwick St., Chicago 10, Ill.
WESTON ELECTRICAL INSTRUMENT CORP., 614 Frelinghuysen Ave., Newark 5, N. J. ADV. PG. 102

DESICCATORS

Bookal & Co., Inc., Wm., 509–519 Vine St., Philadelphia 6, Pa.
Central Scientific Co., 1700 Irving Park Rd., Chicago 13, Ill.
Colloid Equipment Co., Inc., 50 Church St., New York 7, N. Y.
Corning Glass Works, Corning, N. Y.
Fisher Scientific Co., 709 Forbes St., Pittsburgh 19, Pa.
Leader Iron Works, Inc., 2110 N. Jasper, Decatur, Ill.
RADIOACTIVE PRODUCTS, INC., 443 W. Congress St., Detroit, Mich. ADV. PG. 8
Sargent & Co., E. H., 4647 W. Foster Ave., Chicago 30, Ill.
Specialties, Inc., Skunks Misery Road, Syosset, N. Y.
Yonkers Laboratory Supply Co., 70 Palisade Ave., Yonkers 2, N. Y.

DESICCATORS—Micro

Fischer Scientific Co., 709 Forbes St., Pittsburgh 19, Pa.
Scientific Glass Apparatus Co., Inc., 100 Lakewood Terrace, Bloomfield, N. J.
Yonkers Laboratory Supply Co., 70 Palisade Ave., Yonkers 2, N. Y.

DESICCATORS—Vacuum

Central Scientific Co., 1700 Irving Park Rd., Chicago 13, Ill.
Colloid Equipment Co., Inc., 50 Church St., New York 7, N. Y.
Corning Glass Works, Corning, N. Y.
Daylight Vacuum Products Co., 5207 N. Milwaukee Ave., Chicago 30, Ill.
Leader Iron Works, Inc., 2110 N. Jasper, Decatur, Ill.
Yonkers Laboratory Supply Co., 70 Palisade Ave., Yonkers 2, N. Y.

DESKS

Cinema Engineering Co., 1510 W. Verdugo Ave., Burbank, Calif.
Brooklyn Hospital Equipment Co., Inc., 196 Lexington Ave., New York, N. Y.
Lyon Metal Products Inc., 10 Montgomery St., Aurora, Ill.
Metalab Equipment Corp., 270 Duffy Ave., Hicksville, N. Y.
Radioisotope Application Co., 1843 University Ave., Berkeley 3, Calif.
Scientific Service, Inc., 1417 Solano Ave., Albany, Calif.

DETECTORS—Hazardous or Poisonous Gas

Consolidated Engineering Corp., 300 N. Sierra Madre Villa, Pasadena 8, Calif.
Davis Emergency Equipment Co., Inc., 252 Halleck St., Newark, N. J.
Hastings Instrument Co., Super Highway at Pine Ave., Hampton, Va.

MINE SAFETY APPLIANCES CO., 201 N. Braddock Ave., Pittsburgh 21, Pa. ADV. PG. 130
Phoenix Precision Instrument Co., 3803-05 N. 5th St., Philadelphia, Pa.
Rosdel Engineering, 2351 Riverside Drive, Los Angeles 39, Calif.

DETECTORS—Leak

GENERAL ELECTRIC CO., Apparatus Sales Div., Schenectady 5, N. Y. ADV. PGS. 2-5
Magnaflux Corp., 5900 Northwest Highway, Chicago 31, Ill.
Menlo Research Laboratory, Menlo Park, Calif.
NATIONAL RESEARCH CORP., 70 Memorial Drive, Cambridge 42, Mass. ADV. PG. 16
OPTICAL FILM ENGINEERING CO., 2731-37 N. 6th St., Philadelphia 33, Pa. ADV. PG. 106
RADIO CORP. OF AMERICA, TUBE DEPT., Harrison, N. J. ADV. PG. 93
Vacuum-Electronic Engineering Co., 86 Denton Ave., New Hyde Park, N. Y.

DETECTORS—Radiation

See Counters and G-M Listings

DETECTORS—Radiation, Self Powered

Ohmart Corp., The, 2347 Ferguson Ave., Cincinnati 38, Ohio

DETERGENTS

Carbide & Chemicals Co., Div. Union Carbide & Carbon Corp., 30 E. 42nd St., New York 17, N. Y.
du Pont de Nemours & Co., Inc., E. I., Wilmington 98, Del.
General Dyestuff Corp., 435 Hudson St., New York 14, N. Y.
Jasonols Chemical Corp., 1085 Myrtle Ave., Brooklyn 6, N. Y.
Monsanto Chemical Co., 1700 S. Second St., St. Louis 4, Mo.
Varnilon Co., 416 N. Varney St., Burbank, Calif.

DIODES—Germanium

Amperex Electronic Corp., Duffy Ave., Hicksville, N. Y.
Berkshire Laboratories, 588 Beaver Pond Rd., Lincoln, Mass.
General Electric Co., Electronics Div., Electronics Park, Syracuse, N. Y.
Radio Receptor Co., 251 W. 19th St., New York 11, N. Y.
Sylvania Electric Products, Inc., 1740 Broadway, New York 19, N. Y.

DISTILLATION EQUIPMENT

American Copper & Brass Works, Inc., Cincinnati 2, Ohio
Barnstead Still & Sterilizer Co., 222 Lanesville Terrace, Forest Hills, Boston 31, Mass.
Brighton Copper Works, Inc., 2146 Colerain Ave., Cincinnati, Ohio
Daylight Vacuum Products Co., 5207 N. Milwaukee Ave., Chicago 30, Ill.
DISTILLATION PRODUCTS INDUSTRIES, A Division of Eastman Kodak Co., Rochester 3, N. Y. ADV. PG. 91
Eck & Krebs, Inc., 27-09 40th Ave., Long Island City 1, N. Y.
Fischer Scientific Co., 709 Forbes St., Pittsburgh 19, Pa.
Glass Engineering Laboratories, Belmont, Calif.
KONTES GLASS CO., Spruce St., Vineland, N. J. ADV. PG. 126
Pabst Engineering Equipment Co., Inc., Elizabeth, N. J.
Pfaudler Co., 1002 West Ave., Rochester, N. Y.
Precision Scientific Co., 3737 W. Cortland St., Chicago 47, Ill.
Radiation Counter Labs., Inc., 1844 W. 21st St., Chicago 8, Ill.
Sargent & Co., E. H., 4647 W. Foster Ave., Chicago 30, Ill.
Scientific Glass Apparatus Co., Inc., 100 Lakewood Terrace, Bloomfield, N. J.
Yonkers Laboratory Supply Co., 70 Palisade Ave., Yonkers 2, N. Y.

DOSIMETERS

Ansco Division, General Aniline & Film Corp., Binghamton, N. Y.
ANTON ELECTRONIC LABS., INC., 1226-38 Flushing Ave., Brooklyn 37, N. Y. ADV. PG. 136
Baldwin Instrument Co., Ltd., Brooklands Works, Dartford, Kent, England
Bausch & Lomb Optical Co., 630 St. Paul St., Rochester 2, N. Y.
Beckman Instruments, Inc., 820 Mission St., South Pasadena 183, Calif.
CAMBRIDGE INSTRUMENT CO., INC., 3786 Grand Central Terminal, New York 17, N. Y. ADV. PG. 123
Cinema-Television Ltd., Worsley Bridge Rd., London, S. E. 26, England
Clarkston Corp., 11921 SW Pico Blvd., Los Angeles 64, Calif.
COLE, LTD., E. K., Electronics Div., Malmesbury, Wiltshire, England. ADV. PG. 28
Consolidated Engineering Corp., 300 N. Sierra Madre Villa, Pasadena 8, Calif.
Interelectronics Corp., 2432 Grand Concourse, New York 58, N. Y.
Landsverk Electrometer Co., 550-552 W. Garfield Ave., Glendale 4, Calif.
Menlo Research Laboratory, Menlo Park, Calif.
NUCLEAR INSTRUMENT & CHEMICAL CORP., 223 W. Erie St., Chicago 10, Ill. ADV. PG. Back Cover
NUCLEAR RESEARCH CORP., 2563 Grays Ferry Ave., Philadelphia 46, Pa. ADV. PG. 97
Patterson, Moos & Co., Inc., 33-36 47th Ave., Long Island City 1, N. Y.
Process & Instruments, 60 Greenpoint Ave., Brooklyn 22, N. Y.
Rosdel Engineering, 2351 Riverside Drive, Los Angeles 39, Calif.
St. John X-Ray Laboratory, Califon, N. J.
TECHNICAL ASSOCIATES, INC., 140 W. Providencia Ave., Burbank, Calif. ADV. PG. 130
TECHNICAL OPERATIONS, INC., 6 Schouler Court, Arlington 74, Mass. ADV. PG. 128
TRACERLAB, INC., 130 High St., Boston 10, Mass. ADV. PG. 24
VICTOREEN INSTRUMENT CO., 3800 Perkins Ave., Cleveland 14, Ohio. ADV. PG. Inside Front Cover

DOSIMETERS—Chemical

Finkle, Raymond D., 2633 Santa Monica Blvd., Santa Monica, Calif.
Interelectronics Corp., 2432 Grand Concourse, New York 58, N. Y.
TECHNICAL ASSOCIATES, INC., 140 W. Providencia Ave., Burbank, Calif. ADV. PG. 130

DOSIMETERS—Civil Defense

Baldwin Instrument Co., Ltd., Brooklands Works, Dartford, Kent, England
CAMBRIDGE INSTRUMENT CO., INC., 3786 Grand Central Terminal, New York 17, N. Y. ADV. PG. 123
Cinema Television Ltd., Worsley Bridge Rd., London, S. E. 26, England
Clarkston Corp., 11921 SW Pico Blvd., Los Angeles 64, Calif.
Corning Glass Works, Corning, N. Y.
Finkle, Raymond D., 2633 Santa Monica Blvd., Santa Monica, Calif.
Interelectronics Corp., 2432 Grand Concourse, New York 58, N. Y.
Landsverk Electrometer Co., 550-552 W. Garfield Ave., Glendale 4, Calif.
Menlo Research Laboratory, Menlo Park, Calif.
NUCLEAR RESEARCH CORP., 2563 Grays Ferry Ave., Philadelphia 46, Pa. ADV. PG. 97
Radiation Counter Labs., Inc., 1844 W. 21st St., Chicago 8, Ill.
Rosdel Engineering, 2351 Riverside Drive, Los Angeles 39, Calif.
St. John X-Ray Laboratory, Califon, N. J.
TECHNICAL ASSOCIATES, INC., 140 W. Providencia Ave., Burbank, Calif. ADV. PG. 130
TRACERLAB, INC., 130 High St., Boston 10, Mass. ADV. PG. 24
Twentieth Century Electronics, Ltd., Dunbar Works, Dunbar St., West Norwood, London, S. E. 27, England
VICTOREEN INSTRUMENT CO., 3800 Perkins Ave., Cleveland 14, Ohio. ADV. PG. Inside Front Cover

DOSIMETERS—Crystal

R-C SCIENTIFIC INSTRUMENT CO., 335 Culver Blvd., Playa Del Rey, Calif. ADV. PG. 129
TECHNICAL ASSOCIATES, INC., 140 W. Providencia Ave., Burbank, Calif. ADV. PG. 130
TRACERLAB, INC., 130 High St., Boston 10, Mass. ADV. PG. 24

DOSIMETERS—Film

ISOTOPE SPECIALITIES CO., 3816 San Fernando Rd., Glendale, Calif. ADV. PG. 94
R-C SCIENTIFIC INSTRUMENT CO., 335 Culver Blvd., Playa Del Rey, Calif. ADV. PG. 129
St. John X-Ray Laboratory, Califon, N. J.
Samples Machine Co., A. M., 506 N. Central Ave., Knoxville, Tenn.
TECHNICAL ASSOCIATES, INC., 140 W. Providencia Ave., Burbank, Calif. ADV. PG. 130
TRACERLAB, INC., 130 High St., Boston 10, Mass. ADV. PG. 24

DOSIMETERS—G-M

ANTON ELECTRONIC LABS., INC., 1226-38 Flushing Ave., Brooklyn 37, N. Y. ADV. PG. 136
Baldwin Instrument Co., Ltd., Brooklands Works, Dartford, Kent, England
COLE, LTD., E. K., Electronics Div., Malmesbury, Wiltshire, England. ADV. PG. 28
NUCLEONIC CO. OF AMERICA, 497 Union St., Brooklyn 31, N. Y. ADV. PG. 112
Rosdel Engineering, 2351 Riverside Drive, Los Angeles 39, Calif.
TRACERLAB, INC., 130 High St., Boston 10, Mass. ADV. PG. 24
VICTOREEN INSTRUMENT CO., 3800 Perkins Ave., Cleveland 14, Ohio. ADV. PG. Inside Front Cover
Western Radiation Lab., 1107 W. 24th St., Los Angeles 27, Calif.

DOSIMETERS—Ion Chamber

ANTON ELECTRONIC LABS., INC., 1226-38 Flushing Ave., Brooklyn 37, N. Y. ADV. PG. 136
Baldwin Instrument Co., Ltd., Brooklands Works, Dartford, Kent, England
CAMBRIDGE INSTRUMENT CO., INC., 3786 Grand Central Terminal, New York 17, N. Y. ADV. PG. 123
COLE, LTD., E. K., Electronics Div., Malmesbury, Wiltshire, England. ADV. PG. 28
Landsverk Electrometer Co., 550-552 W. Garfield Ave., Glendale 4, Calif.
NUCLEAR INSTRUMENT & CHEMICAL CORP., 223 W. Erie St., Chicago 10, Ill. ADV. PG. Back Cover
Process & Instruments, 60 Greenpoint Ave., Brooklyn 22, N. Y.
Radiation Counter Labs., Inc., 1844 W. 21st St., Chicago 8, Ill.
RADIOACTIVE PRODUCTS, INC., 443 W. Congress St., Detroit, Mich. ADV. PG. 8
Rosdel Engineering, 2351 Riverside Drive, Los Angeles 39, Calif.
TECHNICAL ASSOCIATES, INC., 140 W. Providencia Ave., Burbank, Calif. ADV. PG. 130
TECHNICAL OPERATIONS, INC., 6 Schouler Court, Arlington 74, Mass. ADV. PG. 128
TRACERLAB, INC., 130 High St., Boston 10, Mass. ADV. PG. 24
VICTOREEN INSTRUMENT CO., 3800 Perkins Ave., Cleveland 14, Ohio. ADV. PG. Inside Front Cover

DOSIMETERS—Personnel

Baldwin Instrument Co., Ltd., Brooklands Works, Dartford, Kent, England
Beckman, Inc., Arnold O., 1020 Mission St., South Pasadena, Calif.
CAMBRIDGE INSTRUMENT CO., INC., 3786 Grand Central Terminal, New York 17, N. Y. ADV. PG. 123
Cinema Television Ltd., Worsley Bridge Rd., London, S. E. 26, England
Clarkston Corp., 11921 SW Pico Blvd., Los Angeles 64, Calif.
Consolidated Engineering Corp., 300 N. Sierra Madre Villa, Pasadena 8, Calif.
Corning Glass Works, Corning, N. Y.
Falk & Co., Ltd., M., 9 Victoria St., London, S. W. 1, England
Interelectronics Corp., 2432 Grand Concourse, New York 58, N. Y.
Landsverk Electrometer Co., 550-552 W. Garfield Ave., Glendale 4, Calif.
Manufacturers Engineering & Equipment Corp., York & Mill Rds., Hatboro, Pa.
Menlo Research Laboratory, Menlo Park, Calif.
NUCLEAR INSTRUMENT & CHEMICAL CORP., 223 W. Erie St., Chicago 10, Ill. ADV. PG. Back Cover
NUCLEAR RESEARCH CORP., 2563 Grays Ferry Ave., Philadelphia 46, Pa. ADV. PG. 97
Radiation Counter Labs., Inc., 1844 W. 21st St., Chicago 8, Ill.
Rosdel Engineering, 2351 Riverside Drive, Los Angeles 39, Calif.
St. John X-Ray Laboratory, Califon, N. J.
Samples Machine Co., A. M., 506 N. Central Ave., Knoxville, Tenn.
TECHNICAL ASSOCIATES, INC., 140 W. Providencia Ave., Burbank, Calif. ADV. PG. 130
TECHNICAL OPERATIONS, INC., 6 Schouler Court, Arlington 74, Mass. ADV. PG. 128
TRACERLAB, INC., 130 High St., Boston 10, Mass. ADV. PG. 24
VICTOREEN INSTRUMENT CO., 3800 Perkins Ave., Cleveland 14, Ohio. ADV. PG. Inside Front Cover

DRYERS—Vacuum

See Apparatus—Drying, Vacuum

ELECTRO-ANALYZERS

Alco Scientific Div. of A. S. Alco Co., 5655 Kingsbury Blvd., St. Louis 12, Mo.
Atomlab, Inc., 489 Fifth Ave., New York 17, N. Y.
Central Scientific Co., 1700 Irving Park Rd., Chicago 13, Ill.

Cole Instrument Co., 1320 S. Grand Ave., Los Angeles 15, Calif.
Eberbach Corporation, Ann Arbor, Mich.
Eimer & Amend, Div. of Fisher Scientific Co., 635 Greenwich St., New York, N. Y.
Electro-Mechanical Research, Inc., 64 Main St., Ridgefield, Conn.
Fisher Scientific Co., 709 Forbes St., Pittsburgh 19, Pa.
Hogan Laboratories, Inc., 155 Perry St., New York 14, N. Y.
Instrument Laboratories, 315 W. Walton Place, Chicago, Ill.
Precision Scientific Co., 3737 W. Cortland St., Chicago 47, Ill.
Sargent & Co., E. H., 4647 W. Foster Ave., Chicago 30, Ill.
Square Root Mfg. Corp., 391 Saw Mill River Rd., Yonkers, N. Y.
Telectro Industries Corp., 35–18 37th St., Long Island City 1, N. Y.
Vectron, Inc., 400 Main St., Waltham 54, Mass.

ELECTROLYTIC APPARATUS—Micro

ISOTOPE SPECIALTIES CO., 3816 San Fernando Rd., Glendale, Calif. ADV. PG. 94
Precision Scientific Co., 3737 W. Cortland St., Chicago 47, Ill.
Sargent & Co., E. H., 4647 W. Foster Ave., Chicago 30, Ill.
Scientific Glass Apparatus Co., Inc., 100 Lakewood Terrace, Bloomfield, N. J.
Thomas Co., Arthur H., W. Washington Square, Philadelphia 5, Pa.
WESTON ELECTRICAL INSTRUMENT CO., 614 Frelinghuysen Ave., Newark 5, N. J. ADV. PG. 102

ELECTROMETERS

Atomlab, Inc., 489 Fifth Ave., New York 17, N. Y.
Baldwin Instrument Co., Ltd., Brooklands Works, Dartford, Kent, England
CAMBRIDGE INSTRUMENT CO., INC., 3786 Grand Central Terminal, New York 17, N. Y. ADV. PG. 123
Central Scientific Co., 1700 Irving Park Rd., Chicago 13, Ill.
Coleman Instruments, Inc., Maywood, Ill.
Keithley Instruments, 3868 Carnegie Ave., Cleveland, Ohio
Landsverk Electrometer Co., 550–552 W. Garfield Ave., Glendale 4, Calif.
MINNEAPOLIS-HONEYWELL REGULATOR CO., Wayne & Roberts Aves., Philadelphia 44, Pa. ADV. PG. 29
Ohmart Corp., The, 2347 Ferguson Ave., Cincinnati 38, Ohio
Phoenix Precision Instrument Co., 3803–05 N. 5th St., Philadelphia, Pa.
Rawson Electrical Instrument Co., 114 Potter St., Cambridge 42, Mass.
Special Instruments Laboratory, Inc., 1003 Highland Ave., Knoxville, Tenn.
TECHNICAL OPERATIONS, INC., 6 Schouler Court, Arlington 74, Mass. ADV. PG. 128
VICTOREEN INSTRUMENT CO., 3800 Perkins Ave., Cleveland 14, Ohio. ADV. PG. Inside Front Cover
Western Radiation Lab., 1107 W. 24th St., Los Angeles 27, Calif.

ELECTROMETERS—Vibrating Reed

Applied Physics Corp., 362 W. Colorado St., Pasadena 1, Calif.
COLE, LTD., E. K., Electronics Div., Malmesbery, Wiltshire, England. ADV. PG. 28
MINNEAPOLIS-HONEYWELL REGULATOR CO., Wayne & Roberts Aves., Philadelphia 44, Pa. ADV. PG. 29

FANS—Cooling

Air Controls Inc., 2312 Superior Ave., Cleveland 14, Ohio
American Electric Motors, Inc., 4811–13 Telegraph Rd., Los Angeles, Calif.
BAR-RAY PRODUCTS, INC., 209 25th St., Brooklyn 32, N. Y. ADV. PG. 112
Bogue Electric Mfg. Co., 52 Iowa Ave., Paterson 3, N. J.
Chelsea Fan and Blower Co., Inc., 639 South Ave., Plainfield, N. J.
Clarage Fan Co., 719 Porter St., Kalamazoo, Mich.
Colloid Equipment Co., Inc., 50 Church St., New York 7, N. Y.
Dayton Electric Mfg. Co., 748 W. Adams, Chicago, Ill.
Eastern Air Devices, Inc., 585 Dean St., Brooklyn 17, N. Y.
Electrovent Fan & Mfg. Co., 812 W. Lake St., Chicago 7, Ill.
Fasco Industries, Inc., Rochester 2, N. Y.
General Mixing Equipment Co., 413 N. 3rd St., Philadelphia, Pa.
Globe Industries, Inc., 125 Sunrise Place, Dayton 7, Ohio
Ilg Electric Ventilating Co., 2850 N. Crawford Ave., Chicago 41, Ill.
International Engineering, Inc., 1200 Bolander Ave., Dayton, Ohio
Joy Mfg. Co., Oliver Bldg., Pittsburgh 22, Pa.
Kappers Co., Inc., Kappers Bldg., Pittsburgh, Pa.
Mission Electric Mfg. Co., Inc., 132–134 W. Colorado, Pasadena 1, Calif.
Patrol Mfg. Co., Inc., 7 Schoonmaker Lane, Woodstock, N. Y.
Trane Co., La Crosse, Wis.
United States Air Conditioning Corp., Como Ave. SE at 33rd, Minneapolis 14, Minn.
Western Blower Co., 1800 Airport Way, Seattle 66, Wash.
Westinghouse Electric Corp., P. O. Box 868, Pittsburgh 30, Pa.
York Corp., York, Pa.

FANS—Exhaust

Air Controls, Inc., 2312 Superior Ave., Cleveland 14, Ohio
American Electric Motors, Inc., 4811–13 Telegraph Rd., Los Angeles, Calif.
American Machine Products Co., Marshalltown, Iowa
BAR-RAY PRODUCTS, INC., 209 25th St., Brooklyn 32, N. Y. ADV. PG. 112
Bogue Electric Mfg. Co., 52 Iowa Ave., Paterson 3, N. J.
Century Fan & Ventilator Co., 25 Cedar St., Stamford, Conn.
Chelsea Fan & Blower Co., Inc., 639 South Ave., Plainfield, N. J.
Clarage Fan Co., 719 Porter St., Kalamazoo, Mich.
Colloid Equipment Co., Inc., 50 Church St., New York 7, N. Y.
Day Co., The, 820 Third Ave., NE, Minneapolis 13, Minn.
Dayton Electric Mfg. Co., 748 W. Adams, Chicago, Ill.
De Vilbiss Co., 300 Phillips Ave., Toledo, Ohio
Electric Blower Co., 350 Atlantic Ave., Boston, Mass.
Electrovent Fan & Mfg. Co., 812 W. Lake St., Chicago 7, Ill.
General Mixing Equipment Co., 413 N. 3rd St., Philadelphia, Pa.
Fasco Industries, Inc., Rochester 2, N. Y.
Hirschman-Pohle Co., Inc., 115 Lent Ave., LeRoy, N. Y.
Houston Blow Pipe & Sheet Metal Works, P. O. Box 1692, Houston 1, Texas
Ilg Electric Ventilating Co., 2850 N. Crawford Ave., Chicago 41, Ill.
International Engineering, Inc., 1200 Bolander Ave., Dayton, Ohio
Jordan & Co., Paul R., E. South & New Jersey, Indianapolis, Ind.
Joy Mfg. Co., Oliver Bldg., Pittsburgh 22, Pa.
Kewaunee Mfg. Co., 5083 S. Center St., Adrian, Mich.
Mission Electric Mfg. Co., Inc., 132–134 W. Colorado, Pasadena 1, Calif.
Northern Blower Co., 6427 Barberton Ave., Cleveland 2, Ohio
Trane Co., La Crosse, Wis.
United States Air Conditioning Corp., Como Ave. SE, at 33rd, Minneapolis 14, Minn.
Western Blower Co., 1800 Airport Way, Seattle 66, Wash.
Western Engineering & Mfg. Co., 4112 Ocean Park Ave., Venice, Calif.

FILTER DISKS

Consolidated Siphon Supply Co., 24 Wooster St., New York, N. Y.
Eaton-Dikeman Co., Mount Holly Springs, Pa.
Metal Textile Corp., 647 E. First Ave., Roselle, N. J.
Newark Wire Cloth Co., 351 Verona Ave., Newark 4, N. J.
Sargent & Co., E. H., 4647 W. Foster Ave., Chicago 30, Ill.
Shriver & Co., Inc., 808 Hamilton St., Harrison, N. J.
U. S. GASKET CO., 602 N. 10th St., Camden, N. J. ADV. PG. 135
Varnitan Co., 416 N. Varney St., Burbank, Calif.
Yonkers Laboratory Supply Co., 70 Palisade Ave., Yonkers 2, N. Y.

FILTER PRESSES—Laboratory

Consolidated Siphon Supply Co., 24 Wooster St., New York, N. Y.
Independent Filter Press, 230 48th St., Brooklyn, N. Y.
Shriver & Co., Inc., 808 Hamilton St., Harrison, N. J.
Yonkers Laboratory Supply Co., 70 Palisade Ave., Yonkers 2, N. Y.

FILTERS—Air

American Air Filter Co., Inc., 215 Central Ave., Louisville 8, Ky.
CAMBRIDGE CORP., 351 S. Geddes St., Syracuse, N. Y. ADV. PG. 107
Consolidated Siphon Supply Co., Inc., 24 Wooster St., New York, N. Y.
Conoflow Corp., 2100 Arch St., Philadelphia 3, Pa.
Day Co., The, 820 Third Ave., NE, Minneapolis 13, Minn.
Gas & Oil Industry Laboratories, Inc., 2 Palma Ave., Irvington 11, N. J.
Metal Textile Corp., 647 E. First Ave., Roselle, N. J.
MINE SAFETY APPLIANCES CO., 201 N. Braddock Ave., Pittsburgh 21, Pa. ADV. PG. 130
Northern Blower Co., 6427 Barberton Ave., Cleveland 2, Ohio
Pabst Engineering Equipment Co., Inc., Elizabeth, N. J.
Pulverizing Machinery Co., 43 Chatham Rd., Summit, N. J.
Radioisotope Application Co., 1843 University Ave., Berkeley 3, Calif.
Scientific Service, Inc., 1417 Solano Ave., Albany, Calif.
Taylor Instrument Companies, 95 Ames St., Rochester, N. Y.
Trion, Inc., 1000 Island Ave., McKees Rocks, Pa.
York Corp., York, Pa.

FILTERS—Asbestos

Consolidated Siphon Supply Co., Inc., 24 Wooster St., New York, N. Y.
De Vilbiss Co., 300 Phillips Ave., Toledo, Ohio
Fischer Scientific Co., 709 Forbes St., Pittsburgh 19, Pa.
General Mixing Equipment Co., 413 N. 3rd St., Philadelphia, Pa.
Inflico, Inc., P. O. Box 5033, Tucson, Ariz.

FILTERS—Cotton

Consolidated Siphon Supply Co., Inc., 24 Wooster St., New York, N. Y.
Independent Filter Press, 230 48th St., Brooklyn, N. Y.
Shriver & Co., Inc., 808 Hamilton St., Harrison, N. J.

FILTERS—Metallic

Forrand Optical Co., Inc., Bronx Blvd. at 238th St., New York 70, N. Y.
Inflico, Inc., P. O. Box 5033, Tucson, Ariz.
Jelliff Mfg. Corp., C. O., 122 Pequot Ave., Southport, Conn.
Newark Wire Cloth Co., 351 Verona Ave., Newark 4, N. J.

FILTERS—Rubber

U. S. Rubber Co., 1230 Avenue of the Americas, New York 20, N. Y.

FILTERS—Paper

Angel & Co., Inc., H. Reeve, 52 Duane St., New York, N. Y.
Consolidated Siphon Supply Co., Inc., 24 Wooster St., New York, N. Y.
Eaton-Dikeman Co., Mount Holly Springs, Pa.
Independent Filter Press, 230 48th St., Brooklyn, N. Y.
LEITZ, INC., E., 304 Hudson St. at Spring St., New York 13, N. Y. ADV. PG. 121
Sargent & Co., E. H., 4647 W. Foster Ave., Chicago 30, Ill.
Yonkers Laboratory Supply Co., 70 Palisade Ave., Yonkers 2, N. Y.

FILTERS—Synthetic Fibre

Radioisotope Application Co., 1843 University Ave., Berkeley 3, Calif.
Scientific Service, Inc., 1417 Solano Ave., Albany, Calif.
Shriver & Co., Inc., 808 Hamilton St., Harrison, N. J.
THOMPSON CO., H. I., 1733 Cordova St., Los Angeles 7, Calif. ADV. PG. 120
U. S. GASKET CO., 602 N. 10th St., Camden, N. J. ADV. PG. 135
U. S. Rubber Co., 1230 Avenue of the Americas, New York 20, N. Y.
Varnitan Co., 416 N. Varney St., Burbank, Calif.

FIRE DETECTION SYSTEMS

Edison, Inc., Thomas A., Instrument Div., West Orange, N. J.
Electronic Control Corp., 1573 E. Forest St., Detroit 7, Mich.
Fenwal Inc., 120 Pleasant St., Ashland, Mass.
Firsys Corp., 720 Beacon St., Boston, Mass.
Rendel Engineering, 2351 Riverside Drive, Los Angeles 39, Calif.

FITTINGS—Flared Tube

Edelmann & Co., E., 2332 Logan Blvd., Chicago 47, Ill.
Imperial Brass Mfg. Co., 1200 W. Harrison St., Chicago 7, Ill.

Master's, Inc., W. Irvin, Victor Place & N. Lake St., Burbank, Calif.
SPECIAL SCREW PRODUCTS CO., Bedford, Ohio. ADV. PG. 108
Weatherhead Co., Cleveland 8, Ohio

FLOORING—Acid-proof

Acme Brick Co., P. O. Box 425, Fort Worth 2, Texas
American Mosaic & Tile Co., 331 E. Broadway, Louisville, Ky.
Atlas Mineral Products Co., 131 Norman St., Mertztown, Pa.
Electro Chemical Supply & Engineering Co., 750 Broad St., Emmaus, Pa.
Knight, Maurice A., 171 Kelly Ave., Akron, Ohio
Kraftile Co., Niles, Calif.
Nukem Products Corp., 111 Colgate Ave., Buffalo 20, N. Y.
Sauereisen Cements Co., Sauereisen Bldg., Pittsburgh 15, Pa.
U. S. Stoneware Co., Akron 9, Ohio

FLOORING—Asphalt

Armstrong Cork Co., 1010 Concord St., Lancaster, Pa.
Beck & Sons, Inc., 355 E. 20th St., New York 3, N. Y.
Flintkote Co., 30 Rockefeller Plaza, New York 30, N. Y.
Horn Co., Inc., A. C., 10th St. & 44th Ave., Long Island City 1, N. Y.
Johns-Manville, 22 E. 40th St., New York 16, N. Y.
Mastic Tile Corp. of America, Newburgh, N. Y.
U. S. Stoneware Co., Akron 9, Ohio

FLOORING—Linoleum

Armstrong Cork Co., 1010 Concord St., Lancaster, Pa.
Beck & Sons, Inc., 355 E. 20th St., New York 3, N. Y.
Horn Co., Inc., A. C., 10th St. & 44th Ave., Long Island City 1, N. Y.

FLOORING—Rubber

Armstrong Cork Co., 1010 Concord St., Lancaster, Pa.
Beck & Sons, Inc., 355 E. 20th St., New York 3, N. Y.
Goodyear Tire & Rubber Co., Akron, Ohio
U. S. Stoneware Co., Akron 9, Ohio

FLUOROMETERS

Coleman Instruments, Inc., Maywood, Ill.
Farrand Optical Co., Inc., Bronx Blvd. at E. 238th St., New York 70, N. Y.
Fisher Scientific Co., 709 Forbes St., Pittsburgh 19, Pa.
Phoenix Precision Instrument Co., 3803–05 North 5th St., Philadelphia, Pa.
Photovolt Corp., 95 Madison Ave., New York 16, N. Y.
Scientific Glass Apparatus Co., Inc., 100 Lakewood Terrace, Bloomfield, N. J.

FLUXMETERS

CAMBRIDGE INSTRUMENT CO., INC., 3786 Grand Central Terminal, New York 17, N. Y. ADV. PG. 123
Central Scientific Co., 1700 Irving Park Rd., Chicago 13, Ill.
DYNA LABS., INC., 1075 Stewart Ave., Garden City, N. Y. ADV. PG. 133
GENERAL ELECTRIC CO., Apparatus Sales Div., Schenectady 5, N. Y. ADV. PGS. 2–5
Marion Electrical Instrument Co., 402 Canal St., Manchester, N. H.
Measurement Engineering Ltd., Arnprior, Ontario, Canada
Phoenix Precision Instrument Co., 3803–05 North 5th St., Philadelphia, Pa.
Rawson Electrical Instrument Co., 114 Potter St., Cambridge 42, Mass.
Rubicon Co., Ridge Ave. at 35th St., Philadelphia 32, Pa.
Varian Associates, 990 Varian St., San Carlos, Calif.

FOUNTAINS—Eye

Daylight Vacuum Products Co., 5207 N. Milwaukee Ave., Chicago 30, Ill.
Electronic Control Corp., 1573 E. Forest St., Detroit 7, Mich.
Precision Scientific Co., 3737 W. Cortland St., Chicago 47, Ill.

FUME HOODS

Alberene Stone Corp. of Virginia, 419 Fourth Ave., New York 16, N. Y.
Alco Scientific Div. of A. S. Aloe Co., 5655 Kingsbury Blvd., St. Louis 12, Mo.
BAR-RAY PRODUCTS, INC., 209 25th St., Brooklyn , 32, N. Y. ADV. PG. 112
BLICKMAN, INC., S., 7900 Gregory Ave., Weehawken, N. J. ADV. PG. 30
Bristol Metal Products Corp., Bristol, Tenn.
Emerson-Sack-Warner Corp., 150 Dorchester Ave., South Boston 23, Mass.
Falstrom Co., 7 Falstrom Court, Passaic, N. J.
Fisher Scientific Instrument Co., 709 Forbes St., Pittsburgh 19, Pa.
Hamilton Mfg. Co., Two Rivers, Wis.
Laboratory Furniture Co., Inc., P. O. Box 590, Missoula, N. Y.
Nukem Products Corp., 111 Colgate Ave., Buffalo 20, N. Y.
Pabst Engineering Equipment Co., Inc., Elizabeth, N. J.
Radioisotope Application Co., 1843 University Ave., Berkeley 3, Calif.
Scientific Service, Inc., 1417 Solano Ave., Albany, Calif.
Sheldon Equipment Co., E. H., Muskegon, Mich.
Willson Products, Inc., Reading, Pa.

FURNACES—Combustion, High Temperature

Eclipse Fuel Engineering Co., 705 S. Main St., Rockford, Ill.
Fisher Scientific Co., 709 Forbes St., Pittsburgh 19, Pa.
Harper Electric Furnace Corp., 39 River St., Buffalo 2, N. Y.
Kewaunee Mfg. Co., 5083 S. Center St., Adrian, Mich.
Rockwell Co., W. S., 200 Eliot St., Fairfield, Conn.
Sargent & Co., E. H., 4647 W. Foster Ave., Chicago 30, Ill.
Westinghouse Electric Corp., P. O. Box 868, Pittsburgh 30, Pa.

FURNACES—Electric

Baker & Co., Inc., 113 Astor St., Newark 5, N. J.
Colloid Equipment Co., Inc., 50 Church St., New York 7, N. Y.
Daylight Vacuum Products Co., 5207 N. Milwaukee Ave., Chicago 30, Ill.
Eclipse Fuel Engineering Co., 705 S. Main St., Rockford, Ill.
Eisler Engineering Co., 760 S. 13th St., Newark 3, N. J.
Electric Hotpack Co., Inc., 5035 Cottman Ave., Philadelphia, Pa.
Harper Electric Furnace Corp., 39 River St., Buffalo 2, N. Y.
Hevi Duty Electric Co., 4212 W. Highland Blvd., Milwaukee 1, Wis.
Huppert Co., K. H., 6835 S. Cottage Grove Ave., Chicago 37, Ill.
Leeds & Northrup Co., 4970 Stenton Ave., Philadelphia 44, Pa.
Rockwell Co., W. S., 200 Eliot St., Fairfield, Conn.
Sargent & Co., E. H., 4647 W. Foster Ave., Chicago 30, Ill.
Therme Electric Mfg. Co., 465 Huff, Dubuque, Iowa
Western Gold & Platinum Works, 589 Bryant St., San Francisco, Calif.
Westinghouse Electric Corp., P. O. Box 868, Pittsburgh 30, Pa.

FURNACES—Laboratory

American Instrument Co., Inc., 8030 Georgia Ave., Silver Spring, Md.
Baker & Co., Inc., 113 Astor St., Newark 5, N. J.
Colloid Equipment Co., Inc., 50 Church St., New York 7, N. Y.
Cooper Co., D. C., 1467 S. Michigan Ave., Chicago, Ill.
Daylight Vacuum Products Co., 5207 N. Milwaukee Ave., Chicago 30, Ill.
Eclipse Fuel Engineering Co., 705 S. Main St., Rockford, Ill.
Eisler Engineering Co., 760 S. 13th St., Newark 3, N. J.
Electric Hotpack Co., Inc., 5035 Cottman Ave., Philadelphia, Pa.
Fisher Scientific Co., 709 Forbes St., Pittsburgh 19, Pa.
Harper Electric Furnace Corp., 39 River St., Buffalo 2, N. Y.
Hevi Duty Electric Co., 4212 W. Highland Blvd., Milwaukee 1, Wis.
Hommel Co., O., 209–213 Fourth Ave., Pittsburgh, Pa.
Huppert Co., K. H., 6835 S. Cottage Grove Ave., Chicago 37, Ill.
Lindberg Engineering Co., 2450 W. Hubbard St., Chicago 12, Ill.
Precision Scientific Co., 3737 W. Cortland St., Chicago 47, Ill.
Rockwell Co., W. S., 200 Eliot St., Fairfield, Conn.
Sargent & Co., E. H., 4647 W. Foster Ave., Chicago 30, Ill.
Therme Electric Mfg. Co., 465 Huff, Dubuque, Iowa
Western Gold & Platinum Works, 589 Bryant St., San Francisco, Calif.
Westinghouse Electric Corp., P. O. Box 868, Pittsburgh 30, Pa.
Yonkers Laboratory Supply Co., 70 Palisade Ave., Yonkers 2, N. Y.

FURNACES—Low Temperature

Colloid Equipment Co., Inc., 50 Church St., New York 7, N. Y.
Daylight Vacuum Products Co., 5207 N. Milwaukee Ave., Chicago 30, Ill.
Eclipse Fuel Engineering Co., 705 S. Main St., Rockford, Ill.
Eisler Engineering Co., 760 S. 13th St., Newark 3, N. J.
Harper Electric Furnace Corp., 39 River St., Buffalo 2, N. Y.
Huppert Co., K. H., 6835 S. Cottage Grove Ave., Chicago 37, Ill.
Rockwell Co., W. S., 200 Eliot St., Fairfield, Conn.
Sargent & Co., E. H., 4647 W. Foster Ave., Chicago 30, Ill.
Tenney Engineering, Inc., 26 Avenue B, Newark 5, N. J.
Thomas Co., Arthur H., W. Washington Square, Philadelphia 5, Pa.
Westinghouse Electric Corp., P. O. Box 868, Pittsburgh 30, Pa.

FURNACES—Microcombustion

Alco Scientific Div. of A. S. Aloe Co., 5655 Kingsbury Blvd., St. Louis 12, Mo.
Daylight Vacuum Products Co., 5207 N. Milwaukee Ave., Chicago 30, Ill.
Eclipse Fuel Engineering Co., 705 S. Main St., Rockford, Ill.
Fisher Scientific Co., 709 Forbes St., Pittsburgh 19, Pa.
Hevi Duty Electric Co., 4212 W. Highland Blvd., Milwaukee 1, Wis.
Sargent & Co., E. H., 4647 W. Foster Ave., Chicago 30, Ill.

FURNACES—Muffle

American Instrument Co., Inc., 8030 Georgia Ave., Silver Spring, Md.
Colloid Equipment Co., Inc., 50 Church St., New York 7, N. Y.
Daylight Vacuum Products Co., 5207 N. Milwaukee Ave., Chicago 30, Ill.
Eclipse Fuel Engineering Co., 705 S. Main St., Rockford, Ill.
Electric Hotpack Co., Inc., 5035 Cottman Ave., Philadelphia, Pa.
Harper Electric Furnace Corp., 39 River St., Buffalo 2, N. Y.
Hevi Duty Electric Co., 4212 W. Highland Blvd., Milwaukee 1, Wis.
Huppert Co., K. H., 6835 S. Cottage Grove Ave., Chicago 37, Ill.
Rockwell Co., W. S., 200 Eliot St., Fairfield, Conn.
Sargent & Co., E. H., 4647 W. Foster Ave., Chicago 30, Ill.
Therme Electric Mfg. Co., 465 Huff, Dubuque, Iowa
Western Gold & Platinum Works, 589 Bryant St., San Francisco, Calif.
Westinghouse Electric Corp., P. O. Box 868, Pittsburgh 30, Pa.
Yonkers Laboratory Supply Co., 70 Palisade Ave., Yonkers 2, N. Y.

FURNITURE—Laboratory

Alco Scientific Div. of A. S. Aloe Co., 5655 Kingsbury Blvd., St. Louis 12, Mo.
BLICKMAN, INC., S., 7900 Gregory Ave., Weehawken, N. J. ADV. PG. 30
Brooklyn Hospital Equipment Co., Inc., 196 Lexington Ave., New York, N. Y.
Doehler Metal Furniture Co., Inc., 194 Lexington Ave., New York, N. Y.
Fisher Scientific Co., 709 Forbes St., Pittsburgh 19, Pa.
Gold Seal Mfg. Co., 1230 W. Kinzie St., Chicago 22, Ill.
Hamilton Mfg. Co., Two Rivers, Wis.
Kewaunee Mfg. Co., 5083 S. Center St., Adrian, Mich.
Laboratory Furniture Co., Inc., P. O. Box 590, Missoula, N. Y.
Metalab Equipment Corp., 270 Duffy Ave., Hicksville, N. Y.
Peterson & Co., Inc., Leonard, 1222 Fullerton Ave., Chicago 14, Ill.
Radioisotope Application Co., 1843 University Ave., Berkeley 3, Calif.
Scientific Service, Inc., 1417 Solano Ave., Albany, Calif.
Sheldon Equipment Co., E. H., Muskegon 82, Mich.

FURNACES—Vacuum

See: OVENS, Vacuum

GAGES—Ionization

Consolidated Engineering Corp., 300 N. Sierra Madre Villa, Pasadena 8, Calif.

Daylight Vacuum Products Co., 5207 N. Milwaukee Ave., Chicago 30, Ill.
DISTILLATION PRODUCTS INDUSTRIES, A Division of Eastman Kodak Co., Rochester 3, N. Y. ADV. PG. 91
Douglas Radio Labs., 176 Norfolk Ave., Boston 19, Mass.
Eitel-McCullough, Inc., San Bruno, Calif.
El-Tronics, Inc., 2649 N. Howard St., Philadelphia 33, Pa.
Falk & Co., Ltd., M., 5 Victoria St., London, S. W. 1, England
Fredericks Co., George E., Bethayres, Pa.
GENERAL ELECTRIC CO., Apparatus Sales Div., Schenectady 5, N. Y. ADV. PGS. 2–5
HIGH VOLTAGE ENGINEERING CORP., 7 University Rd., Cambridge 38, Mass. ADV. PG. 20
NATIONAL RESEARCH CORP., 70 Memorial Drive, Cambridge 42, Mass. ADV. PG. 16
OPTICAL FILM ENGINEERING CO., 2731–37 N. 6th St., Philadelphia 33, Pa. ADV. PG. 106
Process & Instruments, 60 Greenpoint Ave., Brooklyn 22, N. Y.
RADIO CORP. OF AMERICA, RCA VICTOR DIV., ENGINEERING PRODUCTS DEPT., Front & Cooper Sts., Camden, N. J. ADV. PG. 13
STOKES MACHINE CO., F. J., Frankford Station P. O., Philadelphia 20, Pa. ADV. PG. 117
TECHNICAL ASSOCIATES, INC., 140 W. Providencia Ave., Burbank, Calif. ADV. PG. 130
Universal X-Ray Products Inc., 1140 N. Western Ave., Chicago 22, Ill.

GAGES—McLeod

Central Scientific Co., 1700 Irving Park Rd., Chicago 13, Ill.
Daylight Vacuum Products Co., 5207 N. Milwaukee Ave., Chicago 30, Ill.
DISTILLATION PRODUCTS INDUSTRIES, A Division of Eastman Kodak Co., Rochester 3, N. Y. ADV. PG. 91
Eck & Krebs, Inc., 27–09 40th Ave., Long Island City 1, N. Y.
Eisler Engineering Co., 760 S. 13th St., Newark 3, N. J.
GENERAL ELECTRIC CO., Apparatus Sales Div., Schenectady 5, N. Y. ADV. PGS. 2–5
KONTES GLASS CO., Spruce St., Vineland, N. J. ADV. PG. 126
Scientific Glass Apparatus Co., Inc., 100 Lakewood Terrace, Bloomfield, N. J.
STOKES MACHINE CO., F. J., Frankford Station P. O., Philadelphia, Pa. ADV. PG. 117
Universal X-Ray Products, Inc., 1140 N. Western Ave., Chicago 22, Ill.
Welch Scientific Co., W. M., 1515 Sedgwick St., Chicago 10, Ill.
Yonkers Laboratory Supply Co., 70 Palisade Ave., Yonkers 2, N. Y.

GAGES—Pirani

Daylight Vacuum Products Co., 5207 N. Milwaukee Ave., Chicago 30, Ill.
DISTILLATION PRODUCTS INDUSTRIES, A Division of Eastman Kodak Co., Rochester 3, N. Y. ADV. PG. 91
Douglas Radio Labs., 176 Norfolk Ave., Boston 19, Mass.
Eisler Engineering Co., 760 S. 13th St., Newark, N. J.
Eitel-McCullough, Inc., San Bruno, Calif.
STOKES MACHINE CO., F. J., Frankford Station P. O., Philadelphia 20, Pa. ADV. PG. 117
Universal X-Ray Products Inc., 1140 N. Western Ave., Chicago 22, Ill.
Winslow Co., Inc., 9 Liberty St., Newark, N. J.

GAGES—Thickness & Density, Radioactivity

Baldwin Instrument Co., Ltd., Brooklands Works, Dartford, Kent, England
COLE, LTD., E. K., Electronics Div., Malmesbury, Wiltshire, England. ADV. PG. 28
Electro Products Labs., Inc., 4501 N. Ravenswood, Chicago 6, Ill.
Falk & Co., Ltd., M., 5 Victoria St., London, S. W. 1, England
Industrial Nucleonics Corp., 1205 Chesapeake Ave., Columbus 12, Ohio
Isotope Products Ltd., Davis Rd., P. O. Box 127, Oakville, Ontario, Canada
Ohmart Corp., The, 2347 Ferguson Ave., Cincinnati 38, Ohio
RADIOACTIVE PRODUCTS, INC., 443 W. Congress St., Detroit, Mich. ADV. PG. 8
Standard Electronics Research Corp., 2 East End Ave., New York 21, N. Y.
TRACERLAB, INC., 130 High St., Boston 10, Mass. ADV. PG. 24
VICTOREEN INSTRUMENT CO., 3800 Perkins Ave., Cleveland 14, Ohio. ADV. PG. Inside Front Cover

GAGES—Vacuum

American Vacuum Co., 816 S. Michigan Ave., Chicago, Ill.
Bristol Co., The, Waterbury 20, Conn.
Central Scientific Co., 1700 Irving Park Rd., Chicago 13, Ill.
Consolidated Engineering Corp., 300 N. Sierra Madre Villa, Pasadena 8, Calif.
Daylight Vacuum Products Co., 5207 N. Milwaukee Ave., Chicago 30, Ill.
DISTILLATION PRODUCTS INDUSTRIES, A Division of Eastman Kodak Co., Rochester 3, N. Y. ADV. PG. 91
Douglas Radio Labs., 176 Norfolk Ave., Boston 19, Mass.
Eisler Engineering Co., 760 S. 13th St., Newark 3, N. J.
Estorino-Angus Co., Inc., P. O. Box 596, Indianapolis 6, Ind.
Fredericks Co., George E., Bethayres, Pa.
GENERAL ELECTRIC CO., Apparatus Sales Div., Schenectady 5, N. Y. ADV. PGS. 2–5
Hastings Instrument Co., Super Highway at Pine St., Hampton, Va.
Kockley Co., O. C., 400 W. Madison St., Chicago 6, Ill.
KONTES GLASS CO., Spruce St., Vineland, N. J. ADV. PG. 126
Manning, Maxwell & Moore, Inc., Stratford, Conn.
Moeller Instrument Co., 132nd St. & 89th Ave., Richmond Hill, N. Y.
NATIONAL RESEARCH CORP., 70 Memorial Drive, Cambridge 42, Mass. ADV. PG. 16
OPTICAL FILM ENGINEERING CO., 2731–37 N. 6th St., Philadelphia 33, Pa. ADV. PG. 106
Pabst Engineering Equipment Co., Inc., Elizabeth, N. J.
Process & Instruments, 60 Greenpoint Ave., Brooklyn 22, N. Y.
Scientific Glass Apparatus Co., Inc., 100 Lakewood Terrace, Bloomfield, N. J.
SCIENTIFIC SPECIALTIES CORP., Snow & Union Sts., Brighton 35, Mass. ADV. PG. 122
Stichl, Inc., Herman H., 27 Park Place, New York 7, N. Y.
RADIO CORP. OF AMERICA, RCA VICTOR DIV., ENGINEERING PRODUCTS DEPT., Front & Cooper Sts., Camden, N. J. ADV. PG. 13
STOKES MACHINE CO., F. J., Frankford Station P. O., Philadelphia 20, Pa. ADV. PG. 117
Sun Electric Corp., 6323 Avondale Ave., Chicago 31, Ill.
U. S. Gauge Div., American Machine & Metals, Inc., Sellersville, Pa.
Universal X-Ray Products Inc., 1140 N. Western Ave., Chicago 22, Ill.
Wallace & Tiernan Products, Inc., Belleville 9, N. J.
Welch Scientific Co., W. M., 1515 Sedgwick St., Chicago 10, Ill.
Wekster Thermometer Corp., Martinique Bldg., 49 W. 32nd St., New York 1, N. Y.

GALVANOMETERS

Berndt-Bach, Inc., 7377 Beverly Rd., Los Angeles 36, Calif.
Biddle Co., James G., 1316 Arch St., Philadelphia 7, Pa.
CAMBRIDGE INSTRUMENT CO., INC., 3786 Grand Central Terminal, New York 17, N. Y. ADV. PG. 123
Central Scientific Co., 1700 Irving Park Rd., Chicago 13, Ill.
Cole Instrument Co., 1320 S. Grand Ave., Los Angeles 15, Calif.
Consolidated Engineering Corp., 300 N. Sierra Madre Villa, Pasadena 8, Calif.
Daylight Vacuum Products Co., 5207 N. Milwaukee Ave., Chicago 30, Ill.
Edin Co., Inc., 207 Main St., Worcester, Mass.
G-M Laboratories, Inc., 4313 N. Knox Ave., Chicago 41, Ill.
GENERAL ELECTRIC CO., Apparatus Sales Div., Schenectady 5, N. Y. ADV. PGS. 2–5
Hickok Electrical Instrument Co., The, 10514 Dupont Ave., Cleveland 8, Ohio
J & T Instruments Inc., 441 Chapel St., New Haven 8, Conn.
Jarrell-Ash Co., 165 Newberry St., Boston 16, Mass.
Leeds & Northrup Co., 4970 Stenton Ave., Philadelphia 44, Pa.
Liston-Becker Instrument Co., Inc., 20 Beckley Ave., Stamford, Conn.
Marion Electrical Instrument Co., 402 Canal St., Manchester, N. H.
Measurement Engineering Ltd., Arnprior, Ontario, Canada
Miller Corp., William, 325 N. Halstead Ave., Pasadena 8, Calif.
Muirhead & Co., Ltd., Beckenham, Kent, England
Phoenix Precision Instrument Co., 3803–05 North 5th St., Philadelphia, Pa.
Rubicon Co., Ridge Ave. at 35th St., Philadelphia 32, Pa.
SANBORN CO., 39 Osborn St., Cambridge 39, Mass. ADV. PG. 92
Shaltcross Mfg. Co., 10 Jackson Ave., Collingdale, Pa.
Simpson Electric Co., Div. of American Gage & Machine Co., 5208 W. Kinzie St., Chicago 44, Ill.
Southwestern Industrial Electronics Co., 2831 Post Oak Rd., P. O. Box 13058, Houston 19, Texas
Sun Electric Corp., 6323 Avondale Ave., Chicago 31, Ill.
Triplett Electrical Instrument Co., 286 Harmon Rd., Bluffton, Ohio
Universal X-Ray Products, Inc., 1140 N. Western Ave., Chicago 22, Ill.
Welch Scientific Co., W. M., 1515 Sedgwick St., Chicago 10, Ill.
WESTON ELECTRICAL INSTRUMENT CORP., 614 Frelinghuysen Ave., Newark 5, N. J. ADV. PG. 102
Winslow Co., Inc., 9 Liberty St., Newark, N. J.

GASES

American Oxygen Service Corp., 600 Essex St., Harrison, N. J.
Wood Counter Laboratory, N., 8491 Blackstone, Chicago 15, Ill.

GASES—Inert

American Oxygen Service Corp., 600 Essex St., Harrison, N. J.
Linde Air Products Co., Div. of Union Carbide & Carbon Corp., 30 E. 42nd St., New York 17, N. Y.

GASES—Liquefied

American Oxygen Service Corp., 600 Essex St., Harrison, N. J.
Mathieson Chemical Corp., Mathieson Bldg., Baltimore 3, Md.

GASES—Rare

American Oxygen Service Corp., 600 Essex St., Harrison, N. J.
Linde Air Products Co., Div. of Union Carbide & Carbon Corp., 30 E. 42nd St., New York 17, N. Y.

GASKETS

Armstrong Cork Co., 1010 Concord St., Lancaster, Pa.
Auburn Mfg. Co., 500 Stack St., Middletown, Conn.
Chase Brass & Copper Co., Inc., Waterbury 20, Conn.
Connecticut Hard Rubber Co., New Haven 9, Conn.
DISTILLATION PRODUCTS INDUSTRIES, A Division of Eastman Kodak Co., Rochester 3, N. Y. ADV. PG. 91
Division Lead Co., 836 W. Kinzie St., Chicago 22, Ill.
Emerson-Sack-Warner Corp., 150 Dorchester Ave., South Boston 23, Mass.
Felt Products Mfg. Co., 1504 W. Carroll Ave., Chicago 7, Ill.
Flexitallic Gasket Co., 8th & Bailey Sts., Camden 2, N. J.
GARDE MFG. CO., 588 Eddy St., Providence, R. I. ADV. PG. 98
Garlock Packing Co., Palmyra, N. Y.
General Electric Co., Chemical Div., 1 Plastics Ave., Pittsfield, Mass.
Goodrich Co., B. F., Akron, Ohio
Hammel-Dahl Co., 175 Post Rd., (Warwick) Providence 5, R. I.
Penn Fibre & Specialty Co., 2030 E. Westmoreland St., Philadelphia 34, Pa.
U. S. GASKET CO., 602 N. 10th St., Camden, N. J. ADV. PG. 135
U. S. Rubber Co., 1230 Avenue of the Americas, New York 20, N. Y.
U. S. Stoneware Corp., Akron 9, Ohio
Western Felt Works, 4029 Ogden Ave., Chicago, Ill.

G-M APPARATUS

Allied Radio Corp., 833 W. Jackson Blvd., Chicago 7, Ill.
ANTON ELECTRONIC LABS., INC., 1226–38 Flushing Ave., Brooklyn 37, N. Y. ADV. PG. 136
ATOMIC INSTRUMENT CO., 84 Massachusetts Ave., Cambridge 39, Mass. ADV. PG. 23
Atomlab, Inc., 489 Fifth Ave. New York 17, N. Y.
Cinema-Television Ltd., Worsley Bridge Rd., London, S. E. 26, England
COLE, LTD., E. K., Electronics Div., Malmesbury, Wiltshire, England. ADV. PG. 28
Cyclotron Specialties Co., Moraga 8, Calif.
Daylight Vacuum Products Co., 5207 N. Milwaukee Ave., Chicago 30, Ill.
Douglas Radio Labs., 176 Norfolk Ave., Boston 19, Mass.
El-Tronics, Inc., 2649 N. Howard St., Philadelphia 33, Pa.
Falk & Co., Ltd., M., 5 Victoria St., London, S. W. 1, England
North American Philips Co., Inc., 100 E. 42nd St., New York 17, N. Y.
NUCLEAR INSTRUMENT & CHEMICAL CORP., 223 W. Erie St., Chicago 10, Ill. ADV. PG. Back Cover
NUCLEAR RESEARCH CORP., 2563 Grays Ferry Ave., Philadelphia 46, Pa. ADV. PG. 97

NUCLEONIC CO. OF AMERICA, 497 Union St., Brooklyn 31, N. Y. ADV. PG. 112
Nucleonics & Radiological Developments Ltd., 77 King's Rd., London, S. W. 3, England
PRECISION RADIATION INSTRUMENTS, 2235 S. LaBrea Ave., Los Angeles 16, Calif. ADV. PG. 108
Process & Instruments, 60 Greenpoint Ave., Brooklyn 22, N. Y.
R-C SCIENTIFIC INSTRUMENT CO., 335 Culver Blvd., Playa Del Rey, Calif. ADV. PG. 129
Radiation Counter Labs., Inc., 1844 W. 21st St., Chicago 8, Ill.
RADIATION INSTRUMENT DEVELOPMENT LAB., 2337 W. 67th St., Chicago 36, Ill. ADV. PG. Inside Back Cover
Rendel Engineering, 2351 Riverside Drive, Los Angeles 39, Calif.
TECHNICAL ASSOCIATES, INC., 140 W. Providencia Ave., Burbank, Calif. ADV. PG. 130
TRACERLAB, INC., 130 High St., Boston 10, Mass. ADV. PG. 24
Twentieth Century Electronics, Ltd., Dunbar Works, Dunbar St., West Norwood, London, S. E. 27, England
VICTOREEN INSTRUMENT CO., 3800 Perkins Ave., Cleveland 14, Ohio. ADV. PG. Inside Front Cover
Western Radiation Lab., 1107 W. 24th St., Los Angeles 27, Calif.
Wood Counter Laboratory, N., 5491 Blackstone, Chicago 15, Ill.

G-M TUBE HOLDERS

Allied Radio Corp., 833 W. Jackson Blvd., Chicago 7, Ill.
ANTON ELECTRONIC LABS., INC., 1226-38 Flushing Ave., Brooklyn 37, N. Y. ADV. PG. 136
ATOMIC INSTRUMENT CO., 84 Massachusetts Ave., Cambridge 39, Mass. ADV. PG. 23
Atomlab, Inc., 489 Fifth Ave., New York 17, N. Y.
COLE, LTD., E. K., Electronics Div., Malmesbury, Wiltshire, England. ADV. PG. 28
Daylight Vacuum Products Co., 5207 N. Milwaukee Ave., Chicago 30, Ill.
Douglas Radio Labs., 176 Norfolk Ave., Boston 19, Mass.
El-Tronics, Inc., 2649 N. Howard St., Philadelphia 33, Pa.
Menlo Research Laboratory, Menlo Park, Calif.
NUCLEAR INSTRUMENT & CHEMICAL CORP., 223 W. Erie St., Chicago 10, Ill. ADV. PG. Back Cover
NUCLEAR RESEARCH CORP., 2563 Grays Ferry Ave., Philadelphia 46, Pa. ADV. PG. 97
NUCLEONIC CO. OF AMERICA, 497 Union St., Brooklyn 31, N. Y. ADV. PG. 112
Radiation Counter Labs., Inc., 1844 W. 21st St., Chicago 8, Ill.
RADIATION INSTRUMENT DEVELOPMENT LAB., 2337 W. 67th St., Chicago 36, Ill. ADV. PG. Inside Back Cover
TECHNICAL ASSOCIATES, INC., 140 W. Providencia Ave., Burbank, Calif. ADV. PG. 130
TECHNICAL OPERATIONS, INC., 6 Schouler Court, Arlington 74, Mass. ADV. PG. 128
TRACERLAB, INC., 130 High St., Boston 10, Mass. ADV. PG. 24
Twentieth Century Electronics, Ltd., Dunbar Works, Dunbar St., West Norwood, London, S. E. 27, England
VICTOREEN INSTRUMENT CO., 3800 Perkins Ave., Cleveland 14, Ohio. ADV. PG. Inside Front Cover
Wood Counter Laboratory, N., 5491 Blackstone, Chicago 15, Ill.

G-M TUBES—Self-Quenching

ABLE SCIENTIFIC GLASS APPARATUS CO., 5041 W. Lake St., Chicago 44, Ill. ADV. PGS. 108, 131, 134
Allied Radio Corp., 833 W. Jackson Blvd., Chicago 7, Ill.
Amperex Electronic Corp., 230 Duffy Ave., Hicksville, N. Y.
ANTON ELECTRONIC LABS., INC., 1226-38 Flushing Ave., Brooklyn 37 N. Y. ADV. PG. 136
Atomlab, Inc., 489 Fifth Ave., New York 17, N. Y.
Cinema-Television Ltd., Worsley Bridge Rd., London, S. E. 26, England
COLE, LTD., E. K., Electronics Div., Malmesbury, Wiltshire, England. ADV. PG. 28
El-Tronics, Inc., 2649 N. Howard St., Philadelphia 33, Pa.
Georator Corp., 1820 N. Nash St., Arlington, Va.
Leighton Labs., H. W., 26 Herman St., Glen Ridge, N. J.
Mullard Overseas, Ltd., Century House, Shaftesbury Ave., London W. C. 2, England
Nuclear Development Laboratory, P. O. Box 7034, Kansas City, Mo.
NUCLEAR INSTRUMENT & CHEMICAL CORP., 223 W. Erie St., Chicago 10, Ill. ADV. PG. Back Cover
NUCLEAR RESEARCH CORP., 2563 Grays Ferry Ave., Philadelphia 46, Pa. ADV. PG. 97
NUCLEONIC CO. OF AMERICA, 497 Union St., Brooklyn 31, N. Y. ADV. PG. 112
Nucleonics & Radiological Developments Ltd., 77 King's Rd., London, S. W. 3, England
Radiation Counter Labs., Inc., 1844 W. 21st St., Chicago 8, Ill.
RADIATION INSTRUMENT DEVELOPMENT LAB., 2337 W. 67th St., Chicago 36, Ill. ADV. PG. Inside Back Cover
RAYTHEON MFG. CO., SPECIAL TUBE SECTION, 55 Chapel St., Newton 58, Mass. ADV. PG. 14
Sylvania Electric Products, Inc., 1740 Broadway, New York 19, N. Y.
TECHNICAL ASSOCIATES, INC., 140 W. Providencia Ave., Burbank, Calif. ADV. PG. 130
TECHNICAL OPERATIONS, INC., 6 Schouler Court, Arlington 74, Mass. ADV. PG. 128
TRACERLAB, INC., 130 High St., Boston 10, Mass. ADV. PG. 24
Twentieth Century Electronics, Ltd., Dunbar Works, Dunbar St., West Norwood, London, S. E. 27, England
VICTOREEN INSTRUMENT CO., 3800 Perkins Ave., Cleveland 14, Ohio. ADV. PG. Inside Front Cover
Welch Allyn, Inc., Skaneateles Falls, N. Y.
Western Radiation Lab., 1107 W. 24th St., Los Angeles 27, Calif.
Wood Counter Laboratory, N., 5491 Blackstone, Chicago 15, Ill.

G-M TUBES—Thick Wall, Glass

ABLE SCIENTIFIC GLASS APPARATUS CO., 5041 W. Lake St., Chicago 44, Ill. ADV. PGS. 108, 131, 134
Allied Radio Corp., 833 W. Jackson Blvd., Chicago 7, Ill.
Amperex Electronic Corp., 230 Duffy Ave., Hicksville, N. Y.
ANTON ELECTRONIC LABS., INC., 1226-38 Flushing Ave., Brooklyn 37, N. Y. ADV. PG. 136
Atomlab, Inc., 489 Fifth Ave., New York 17, N. Y.
Cinema-Television Ltd., Worsley Bridge Rd., London, S. E. 26, England
COLE, LTD., E. K., Electronics Div., Malmesbury, Wiltshire, England. ADV. PG. 28
Daylight Vacuum Products Co., 5207 N. Milwaukee Ave., Chicago 30, Ill.
Eck & Krebs, Inc., 27-09 40th Ave., Long Island City 1, N. Y.
Electronic Products Co., 111 E. Third St., Mount Vernon, N. Y.
El-Tronics, Inc., 2649 N. Howard St., Philadelphia 33, Pa.
Manufacturers Engineering & Equipment Corp., York & Mill Rds., Hatboro, Pa.
Mullard Overseas Ltd., Century House, Shaftesbury Ave., London W. C. 2, England
Nuclear Development Laboratory, P. O. Box 7034, Kansas City, Mo.
NUCLEAR INSTRUMENT & CHEMICAL CORP., 223 W. Erie St., Chicago 10, Ill. ADV. PG. Back Cover
NUCLEAR RESEARCH CORP., 2563 Grays Ferry Ave., Philadelphia 46, Pa. ADV. PG. 97
NUCLEONIC CO. OF AMERICA, 497 Union St., Brooklyn 31, N. Y. ADV. PG. 112
Nucleonics & Radiological Developments Ltd., 77 King's Rd., London, S. W. 3, England
Process & Instruments, 60 Greenpoint Ave., Brooklyn 22, N. Y.
Radiation Counter Labs., Inc., 1844 W. 21st St., Chicago 8, Ill.
RADIATION INSTRUMENT DEVELOPMENT LAB., 2337 W. 67th St., Chicago 36, Ill. ADV. PG. Inside Back Cover
RAYTHEON MFG. CO., SPECIAL TUBE SECTION, 55 Chapel St., Newton 58, Mass. ADV. PG. 14
TECHNICAL ASSOCIATES, INC., 140 W. Providencia Ave., Burbank, Calif. ADV. PG. 130
TRACERLAB, INC., 130 High St., Boston 10, Mass. ADV. PG. 24
Twentieth Century Electronics, Ltd., Dunbar Works, Dunbar St., West Norwood, London, S. E. 27, England
Western Radiation Lab., 1107 W. 24th St., Los Angeles 27, Calif.
Wood Counter Laboratory, N., 5491 Blackstone, Chicago 15, Ill.

G-M TUBES—Thick Wall, Metal

Allied Radio Corp., 833 W. Jackson Blvd., Chicago 7, Ill.
Amperex Electronic Corp., 230 Duffy Ave., Hicksville, N. Y.
ANTON ELECTRONIC LABS., INC., 1226-38 Flushing Ave., Brooklyn 37, N. Y. ADV. PG. 136
Atomlab, Inc., 489 Fifth Ave., New York 17, N. Y.
Daylight Vacuum Products Co., 5207 N. Milwaukee Ave., Chicago 30, Ill.
Electronic Products Co., 111 E. Third St., Mount Vernon, N. Y.
El-Tronics, Inc., 2649 N. Howard St., Philadelphia 33, Pa.
Georator Corp., 1820 N. Nash St., Arlington, Va.
Mullard Overseas Ltd., Century House, Shaftesbury Ave., London W. C. 2, England
Nuclear Development Laboratory, P. O. Box 7034, Kansas City, Mo.
NUCLEAR INSTRUMENT & CHEMICAL CORP., 223 W. Erie St., Chicago 10, Ill. ADV. PG. Back Cover
NUCLEONIC CO. OF AMERICA, 497 Union St., Brooklyn 31, N. Y. ADV. PG. 112
Nucleonics & Radiological Developments Ltd., 77 King's Rd., London, S. W. 3, England
Radiation Counter Labs., Inc., 1844 W. 21st St., Chicago 8, Ill.
RADIATION INSTRUMENT DEVELOPMENT LAB., 2337 W. 67th St., Chicago 36, Ill. ADV. PG. Inside Back Cover
TECHNICAL ASSOCIATES, INC., 140 W. Providencia Ave., Burbank, Calif. ADV. PG. 130
TRACERLAB, INC., 130 High St., Boston 10, Mass. ADV. PG. 24
Twentieth Century Electronics, Ltd., Dunbar Works, Dunbar St., West Norwood, London, S. E. 27, England
VICTOREEN INSTRUMENT CO., 3800 Perkins Ave., Cleveland 14, Ohio. ADV. PG. Inside Front Cover
Western Radiation Lab., 1107 W. 24th St., Los Angeles 27, Calif.
Wood Counter Laboratory, N., 5491 Blackstone, Chicago 15, Ill.

G-M TUBES—Thin Wall

ABLE SCIENTIFIC GLASS APPARATUS CO., 5041 W. Lake St., Chicago 44, Ill. ADV. PGS. 108, 131, 134
Allied Radio Corp., 833 W. Jackson Blvd., Chicago 7, Ill.
Amperex Electronic Corp., 230 Duffy Ave., Hicksville, N. Y.
ANTON ELECTRONIC LABS., INC., 1226-38 Flushing Ave., Brooklyn 37, N. Y. ADV. PG. 136
Atomlab, Inc., 489 Fifth Ave., New York 17, N. Y.
Cinema-Television Ltd., Worsley Bridge Rd., London, S. E. 26, England
COLE, LTD., E. K., Electronics Div., Malmesbury, Wiltshire, England. ADV. PG. 28
Daylight Vacuum Products Co., 5207 N. Milwaukee Ave., Chicago 30, Ill.
Detectron Co., 5631 Cahuenga Blvd., North Hollywood, Calif.
Eck & Krebs, Inc., 27-09 40th Ave., Long Island City 1, N. Y.
Electronic Products Co., 111 E. Third St., Mount Vernon, N. Y.
El-Tronics, Inc., 2649 N. Howard St., Philadelphia 33, Pa.
Leighton Labs., H. W., 26 Herman St., Glen Ridge, N. Y.
Mullard Overseas Ltd., Century House, Shaftesbury Ave., London W. C. 2, England
Nuclear Development Laboratory, P. O. Box 7034, Kansas City, Mo.
NUCLEAR INSTRUMENT & CHEMICAL CORP., 223 W. Erie St., Chicago 10, Ill. ADV. PG. Back Cover
NUCLEAR RESEARCH CORP., 2563 Grays Ferry Ave., Philadelphia 46, Pa. ADV. PG. 97
NUCLEONIC CO. OF AMERICA, 497 Union St., Brooklyn 31, N. Y. ADV. PG. 112
Nucleonics & Radiological Developments Ltd., 77 King's Rd., London, S. W. 3, England
Radiation Counter Labs., Inc., 1844 W. 21st St., Chicago 8, Ill.
RADIATION INSTRUMENT DEVELOPMENT LAB., 2337 W. 67th St., Chicago 36, Ill. ADV. PG. Inside Back Cover
RAYTHEON MFG. CO., SPECIAL TUBE SECTION, 55 Chapel St., Newton 58, Mass. ADV. PG. 14
Red Bank Division, Bendix Aviation Corp., Eatontown, N. J.
TECHNICAL ASSOCIATES, INC., 140 W. Providencia Ave., Burbank, Calif. ADV. PG. 130
TRACERLAB, INC., 130 High St., Boston 10, Mass. ADV. PG. 24
Twentieth Century Electronics, Ltd., Dunbar Works, Dunbar St., West Norwood, London, S. E. 27, England
VICTOREEN INSTRUMENT CO., 3800 Perkins Ave., Cleveland 14, Ohio. ADV. PG. Inside Front Cover
Western Radiation Lab., 1107 W. 24th St., Los Angeles 27, Calif.
Wood Counter Laboratory, N., 5491 Blackstone, Chicago 15, Ill.

G-M TUBES—Thin Window

ABLE SCIENTIFIC GLASS APPARATUS CO., 5041 W. Lake St., Chicago 44, Ill. ADV. PGS. 108, 131, 134
Allied Radio Corp., 833 W. Jackson Blvd., Chicago 7, Ill.
Amperex Electronic Corp., 230 Duffy Ave., Hicksville, N. Y.
ANTON ELECTRONIC LABS., INC., 1226-38 Flushing Ave., Brooklyn 37, N. Y. ADV. PG. 136
Atomlab, Inc., 489 Fifth Ave., New York 17, N. Y.
Cinema-Television Ltd., Worsley Bridge Rd., London, S. E. 26, England
COLE, LTD., E. K., Electronics Div., Malmesbury, Wiltshire, England. ADV. PG. 28

Cyclotron Specialties Co., Moraga 8, Calif.
Daylight Vacuum Products Co., 5207 N. Milwaukee Ave., Chicago 30, Ill.
Electronic Products Co., 111 E. Third St., Mount Vernon, N. Y.
El-Tronics, Inc., 2649 N. Howard St., Philadelphia 33, Pa.
Mullard Overseas Ltd., Century House, Shaftesbury Ave., London W. C. 2, England
Nuclear Development Laboratory, P. O. Box 7034, Kansas City, Mo.
NUCLEAR INSTRUMENT & CHEMICAL CORP., 223 W. Erie St., Chicago 10, Ill. ADV. PG. Back Cover
NUCLEAR RESEARCH CORP., 2563 Grays Ferry Ave., Philadelphia 46, Pa. ADV. PG. 97
NUCLEONIC CO. OF AMERICA, 497 Union St., Brooklyn 3, N. Y. ADV. PG. 112
Nucleonics & Radiological Developments Ltd., 77 King's Rd., London, S. W. 3, England
Radiation Counter Labs., Inc., 1844 W. 21st St., Chicago 8, Ill.
RADIATION INSTRUMENT DEVELOPMENT LAB., 2337 W. 67th St., Chicago 36, Ill. ADV. PG. Inside Back Cover
Red Bank Division, Bendix Aviation Corp., Eatontown, N. J.
TECHNICAL ASSOCIATES, INC., 140 W. Providencia Ave., Burbank, Calif. ADV. PG. 130
TECHNICAL OPERATIONS, INC., 6 Schouler Court, Arlington 74, Mass. ADV. PG. 128
TRACERLAB, INC., 130 High St., Boston 10, Mass. ADV. PG. 24
Twentieth Century Electronics, Ltd., Dunbar Works, Dunbar St., West Norwood, London, S. E. 27, England
VICTOREEN INSTRUMENT CO., 3800 Perkins Ave., Cleveland 14, Ohio. ADV. PG. Inside Front Cover
Wood Counter Laboratory, N., 5491 Blackstone, Chicago 15, Ill.

GENERATORS—Audio Frequency

Airmec Laboratories, Ltd., High Wycombe, Buckinghamshire, England
Allied Radio Corp., 833 W. Jackson Blvd., Chicago 7, Ill.
Audio Instrument Co., 133 W. 14th St., New York 11, N. Y.
Cinema-Television Ltd., Worsley Bridge Rd., London, S. E. 26, England
Clough Brengle Co., 6014 N. Broadway, Chicago, Ill.
Communication Measurement Lab., Inc., 350 Leland Ave., Plainfield, N. J.
Cossor (Canada) Ltd., 301 Windsor St., Halifax, N. S., Canada
Daven Co., 191 Central Ave., Newark 4, N. J.
Decade Instrument Co., P. O. Box 153, Caldwell, N. J.
Douglas Radio Labs., 176 Norfolk Ave., Boston 19, Mass.
Electric & Musical Industries, Ltd., Hayes, Middlesex, England
Elm Laboratories, 18 South Broadway, Dobbs Ferry, N. Y.
Electronic Instrument Co., Inc., 276 Newport St., Brooklyn 12, N. Y.
El-Tronics, Inc., 2649 N. Howard St., Philadelphia 33, Pa.
General Radio Co., 275 Massachusetts Ave., Cambridge 39, Mass.
Hickok Electrical Instrument Co., The, 10514 Dupont Ave., Cleveland 8, Ohio
Interelectronics Corp., 2432 Grand Concourse, New York 58, N. Y.
Krohn-Hite Instrument Co., 580 Massachusetts Ave., Cambridge 39, Mass.
Leland Instruments Ltd., 22–23 Millbank, London, S. W. 1, England
Marconi Instruments, Ltd., 23–25 Beaver St., New York 4, N. Y.
Measurement Engineering Ltd., Arnprior, Ontario, Canada
MEASUREMENTS CORP., Boonton, N. J. ADV. PG. 95
Muirhead & Co., Ltd., Beckenham, Kent, England
Radio City Products Co., Inc., 152 W. 25th St., New York 1, N. Y.
Rexdel Engineering, 2351 Riverside Drive, Los Angeles 39, Calif.
Square Root Mfg. Corp., 391 Saw Mill River Rd., Yonkers, N. Y.
T. L. G. Electric Corp., 31 W. 27th St., New York 1, N. Y.
Telectro Industries Corp., 35–18 37th St., Long Island City 1, N. Y.
Telotronics Laboratory, Inc., Kinkel St., Waterbury, N. Y.
Vectron, Inc., 400 Main St., Waltham 54, Mass.
Walkirt Co., 145 W. Hazel, Inglewood, Calif.
Waveforms, Inc., 333 Sixth Ave., New York 14, N. Y.

GENERATORS—Motor

Allied Radio Corp., 833 W. Jackson Blvd., Chicago 7, Ill.
Allis-Chalmers Mfg. Co., 935 S. 70th St., Milwaukee 1, Wis.
Allis Co., Louis, 427 E. Stewart St., Milwaukee 7, Wis.
American Electric Motors, Inc., 4811–13 Telegraph Rd., Los Angeles, Calif.
Bogue Electric Mfg. Co., 52 Iowa Ave., Paterson 3, N. J.
Bogue Railway Equipment Div. of Bogue Electric Mfg. Co., 52 Iowa Ave., Paterson 3, N. J.
Carter Motor Co., 2644 N. Maplewood Ave., Chicago 47, Ill.
Century Electric Co., 1806 Pine St., St. Louis 3, Mo.
Eastern Air Devices, Inc., 585 Dean St., Brooklyn 17, N. Y.
Electric Machinery Mfg. Co., 1331 N. E. Tyler St., Minneapolis 13, Minn.
Electric Products Co., 1725 Clarkstone Rd., Cleveland 12, Ohio
Electric Specialty Co., 211 South St., Stamford, Conn.
Generator Corp., 1820 N. Nash St., Arlington, Va.
Gaston Power Tools, Inc., 14829 Loomis St., Harvey, Ill.
Gothard Mfg. Co., 2110 Clear Lake Ave., Springfield, Ill.
Great Lakes Electric Mfg. Co., 17 S. Desplaines St., Chicago 6, Ill.
Holtzer-Cabot Div. of National Pneumatic Co., 130 Amory St., Boston 19, Mass.
Howard Industries, Inc., Divisions: Cyclohm Motor Corp., Electric Motor Corp., Racine, Wis.
Inset, Inc., 8655 S. Main St., Los Angeles 3, Calif.
Kahlenberg Bros. Co., 12th & Monroe Sts., Two Rivers, Wis.
Leland Electric Co., The, Div. of American Machine & Foundry Co., 1301 Webster St., Dayton 1, Ohio
Mission Electric Mfg. Co., Inc., 132–134 W. Colorado, Pasadena 1, Calif.
Motorsearch Co., 1600 Junction Ave., Racine, Wis.
Redmond Co., Inc., Owosso, Mich.
Small Motors, Inc., 2076 Elston Ave., Chicago 14, Ill.
Westinghouse Electric Corp., P. O. Box 868, Pittsburgh 30, Pa.
Wincharger Corp., E., 7th & Division Sts., Sioux City, Iowa

GENERATORS—Pulse

Advance Electronics Co., 451 Highland Ave., Passaic, N. J.
Air Associates, Inc., Teterboro, N. J.
American Electronic Laboratories, Inc., 641 Arch St., Philadelphia, 6, Pa.
Atomlab, Inc., 489 Fifth Ave., New York 17, N. Y.
Berkeley Scientific Div. of Beckman Instruments, 2200 Wright Ave., Richmond, Calif.
Berkshire Laboratories, 588 Beaver Pond Rd., Lincoln, Mass.
Canadian Marconi Co., P. O. Box 1690 (Place D'Armes), Montreal, Quebec, Canada
Chatham Electronics Corp., 475 Washington St., Newark 2, N. J.
Cinema-Television Ltd., Worsley Bridge Rd., London, S. E. 26, England
Cossor (Canada) Ltd., 301 Windsor St., Halifax, N. S., Canada
Electro-Mechanical Research, Inc., 64 Main St., Ridgefield, Conn.
Electro Products Labs., Inc., 4501 N. Ravenswood, Chicago 6, Ill.
El-Tronics, Inc., 2649 N. Howard St., Philadelphia 33, Pa.
Fleming Radio Ltd., 18–20 Laystall St., London, E. C. 1, England
General Radio Co., 275 Massachusetts Ave., Cambridge 39, Mass.
Kay Electric Co., 25 Maple Ave., Pine Brook, N. J.
Lavoie Laboratories, Morganville, N. J.
Leland Instruments Ltd., 22–23 Millbank, London, S. W. 1, England
Manson Laboratories, 207 Greenwich Ave., Stamford, Conn.
Marconi Instruments, Ltd., 23–25 Beaver St., New York 4, N. Y.
MEASUREMENTS CORP., Boonton, N. J. ADV. PG. 95
Mercury Electronic Co., Box 450, Red Bank, N. J.
NUCLEAR INSTRUMENT & CHEMICAL CORP., 223 W. Erie St., Chicago 10, Ill. ADV. PG. Back Cover
Oak Ridge Products Mfg. Div., Video Television, Inc., 37–01 Vernon Blvd., Long Island City 1, N. Y.
Radiation Counter Labs., Inc., 1844 W. 21st St., Chicago 8, Ill.
RADIATION INSTRUMENT DEVELOPMENT LAB., 2337 W. 67th St., Chicago 36, Ill. ADV. PG. Inside Back Cover
Rexdel Engineering, 2351 Riverside Drive, Los Angeles 39, Calif.
Rutherford Electronics Corp., 3707 S. Robertson Blvd., Culver City, Calif.
Sierra Electronic Corp., San Carlos, Calif.
SPENCER-KENNEDY LABS., INC., 186 Massachusetts Ave., Cambridge 39, Mass. ADV. PG. 12
Square Root Mfg. Corp., 391 Saw Mill River Rd., Yonkers, N. Y.
Tektronix, Inc., P. O. Box 831, Portland 7, Ore.
Telechrome, Inc., 88 Merrick Road, Amityville, N. Y.
Telotronics Laboratory, Inc., Kinkel St., Waterbury, N. Y.
Television Equipment Corp., 238 William St., New York, N. Y.
Walkirt Co., 145 W. Hazel, Inglewood, Calif.
West Coast Electronics Co., 5873 W. Jefferson, Los Angeles 16, Calif.
Wilmotte, Inc., Raymond M., 1469 Church St., NW, Washington 5, D. C.

GENERATORS—Signal

Air Associates, Inc., Teterboro, N. J.
Airmec Laboratories, Ltd., High Wycombe, Buckinghamshire, England
Allied Radio Corp., 833 W. Jackson Blvd., Chicago 7, Ill.
Avion Instrument Corp., Paramus, N. J.
Boonton Radio Corp., Boonton, N. J.
Cinema Television Ltd., Worsley Bridge Rd., London, S. E. 26, England
Clough Brengle Co., 6014 N. Broadway, Chicago, Ill.
Cossor (Canada) Ltd., 301 Windsor St., Halifax, N. S., Canada
Daven Co., 191 Central Ave., Newark 4, N. J.
Decade Instrument Co., P. O. Box 153, Caldwell, N. J.
Eclipse-Pioneer Div., Bendix Aviation Corp., Teterboro, N. J.
Electric & Musical Industries Ltd., Hayes, Middlesex, England
Electronic Instrument Co., Inc., 276 Newport St., Brooklyn 12, N. Y.
Electronic Measurements Co., Inc., Lewis St. & Maple Ave., Eatontown, N. J.
El-Tronics, Inc., 2649 N. Howard St., Philadelphia 33, Pa.
Empire Devices, Inc., 38–25 Bell Blvd., Bayside 61, N. Y.
General Electric Co., Electronics Div., Electronics Park, Syracuse, N. Y.
General Radio Co., 275 Massachusetts Ave., Cambridge 39, Mass.
Hickok Electrical Instrument Co., The, 10514 Dupont Ave., Cleveland 8, Ohio
Howard Industries, Inc., Divisions: Cyclohm Motor Corp., Electric Motor Corp., Racine, Wis.
Interelectronics Corp., 2432 Grand Concourse, New York 58, N. Y.
Kay Electric Co., 25 Maple Ave., Pine Brook, N. J.
Leland Instruments Ltd., 22–23 Millbank, London, S. W. 1, England
Marconi Instruments Ltd., 23–25 Beaver St., New York 4, N. Y.
Measurement Engineering Ltd., Arnprior, Ontario, Canada
MEASUREMENTS CORP., Boonton, N. J. ADV. PG. 95
Mercury Electronic Co., Box 450, Red Bank, N. J.
Metropolitan Electronics & Instruments Co., 106 Fifth Ave., New York 11, N. Y.
Oak Ridge Products Mfg. Div., Video Television, Inc., 37–01 Vernon Blvd., Long Island City 1, N. Y.
New London Instrument Co., P. O. Box 189, New London, Conn.
Polarad Electronics Corp., 100 Metropolitan Ave., Brooklyn 11, N. Y.
Polytechnic Research & Development Co., 55 Johnson St., Brooklyn 1, N. Y.
Precision Apparatus Co., Inc., 92–27 Horace Harding Blvd., Elmhurst, N. Y.
Radio City Products Co., Inc., 152 W. 25th St., New York 1, N. Y.
RADIO CORP. OF AMERICA, TUBE DEPT., Harrison, N. J. ADV. PG. 92
Rexdel Engineering, 2351 Riverside Drive, Los Angeles 39, Calif.
Rollin Co., 2010 Lincoln Ave., Pasadena 3, Calif.
Servo Corp. of America, 2020 Jericho Turnpike, New Hyde Park, N. Y.
Simpson Electric Co., Div. of American Gage & Machine Co., 5200 W. Kinzie St., Chicago 44, Ill.
Sperry Gyroscope Co., Great Neck, N. Y.
Square Root Mfg. Corp., 391 Saw Mill River Rd., Yonkers, N. Y.
Sylvania Electric Products, Inc., 1740 Broadway, New York 19, N. Y.
Technology Instrument Corp., 531 Main St., Acton, Mass.
Telechrome, Inc., 88 Merrick Road, Amityville, N. Y.
Telectro Industries Corp., 35–18 37th St., Long Island City 1, N. Y.
Television Equipment Corp., 238 William St., New York, N. Y.
Triplett Electrical Instrument Co., 286 Harmon Rd., Bluffton, Ohio
Varo Mfg. Co., Inc., Box 630, Garland, Texas
Vectron, Inc., 400 Main St., Waltham 54, Mass.
Walkirt Co., 145 W. Hazel, Inglewood, Calif.
Waveforms, Inc., 333 Sixth Ave., New York 14, N. Y.

GENERATORS—Square Wave

Air Associates, Inc., Teterboro, N. J.
Allied Radio Corp., 833 W. Jackson Blvd., Chicago 7, Ill.
American Electronic Laboratories, Inc., 641 Arch St., Philadelphia 6, Pa.
Atomlab, Inc., 489 Fifth Ave., New York 17, N. Y.
Central Scientific Co., 1700 Irving Park Rd., Chicago 13, Ill.
Cinema-Television Ltd., Worsley Bridge Rd., London S. E. 26, England
Cossor (Canada) Ltd., 301 Windsor St., Halifax, N. S., Canada
Douglas Radio Labs., 176 Norfolk Ave., Boston 19, Mass.
Electro-Mechanical Research, Inc., 64 Main St., Ridgefield, Conn.
Elm Laboratories, 18 South Broadway, Dobbs Ferry, N. Y.
El-Tronics, Inc., 2649 N. Howard St., Philadelphia 33, Pa.
Fleming Radio Ltd., 18–20 Leystell St., London, E. C. 1, England
General Radio Co., 275 Massachusetts Ave., Cambridge 39, Mass.
Heath Co., Benton Harbor, Mich.
Hickok Electrical Instrument Co., The, 10514 Dupont Ave., Cleveland 8, Ohio
Interelectronics Corp., 2432 Grand Concourse, New York 58, N. Y.
Krohn-Hite Instrument Co., 580 Massachusetts Ave., Cambridge 39, Mass.
Leland Instruments Ltd., 22–23 Millbank, London, S. W. 1, England
Marconi Instruments, Ltd., 23–25 Beaver St., New York 4, N. Y.
Measurement Engineering Ltd., Arnprior, Ontario, Canada
MEASUREMENTS CORP., Boonton, N. J. ADV. PG. 96
Mercury Electronic Co., Box 450, Red Bank, N. J.
Metropolitan Electronics & Instruments Co., 106 Fifth Ave., New York 11, N. Y.
New London Instrument Co., P. O. Box 189, New London, Conn.
Radio City Products Co., Inc., 152 W. 25th St., New York 1, N. Y.
RADIO CORP. OF AMERICA, TUBE DEPT., Harrison, N. J. ADV. PG. 93
Resdel Engineering, 2351 Riverside Drive, Los Angeles 39, Calif.
Rutherford Electronics Corp., 3707 S. Robertson Blvd., Culver City, Calif.
Servo Corp. of America, 2020 Jericho Turnpike, New Hyde Park, N. Y.
Square Root Mfg. Corp., 391 Saw Mill River Rd., Yonkers, N. Y.
Sylvania Electric Products, Inc., 1740 Broadway, New York 19, N. Y.
Telechrome, Inc., 88 Merrick Road, Amityville, N. Y.
Television Equipment Corp., 238 William St., New York, N. Y.
Tektronix, Inc., P. O. Box 831, Portland 7, Ore.
Vectron, Inc., 400 Main St., Waltham 54, Mass.
Walkirt Co., 145 W. Hazel, Inglewood, Calif.
Waveforms, Inc., 333 Sixth Ave., New York 14, N. Y.

GLASS APPARATUS—Special

ABLE SCIENTIFIC GLASS APPARATUS CO., 5041 W. Lake St., Chicago 44, Ill. ADV. PGS. 108, 131, 134
Corning Glass Works, Corning, N. Y.
Daylight Vacuum Products Co., 5207 N. Milwaukee Ave., Chicago 30, Ill.
DISTILLATION PRODUCTS INDUSTRIES, A Division of Eastman Kodak Co., Rochester 3, N. Y. ADV. PG. 91
Fischer & Porter Co., 50 County Line Rd., Hatboro, Pa.
Fish-Schurman Corp., 70 Portman Rd., New Rochelle, N. Y.
Fisher Scientific Co., 709 Forbes St., Pittsburgh 19, Pa.
Fredericks Co., George E., Bethayres, Pa.
Glass Engineering Laboratories, Belmont, Calif.
Jasonais Chemical Corp., 1085 Myrtle Ave., Brooklyn 6, N. Y.
KONTES GLASS CO., Spruce St., Vineland, N. J. ADV. PG. 126
Milwaukee Glass Works, Inc., 2338 N. 30th St., Milwaukee, Wis.
Phipps & Bird, Inc., 303 S. 6th St., Richmond 5, Va.
Phoenix Precision Instrument Co., 3803–05 North 5th St., Philadelphia, Pa.
Process & Instruments, 40 Greenpoint Ave., Brooklyn 22, N. Y.
RADIATION INSTRUMENT DEVELOPMENT LAB., 2337 W. 67th St., Chicago 36, Ill. ADV. PG. Inside Back Cover
Radioisotope Application Co., 1843 University Ave., Berkeley 3, Calif.
Sargent & Co., E. H., 4647 W. Foster Ave., Chicago 30, Ill.
Scientific Glass Apparatus Co., Inc., 100 Lakewood Terrace, Bloomfield, N. J.
Scientific Service, Inc., 1417 Solano Ave., Albany, Calif.
Special Glass Products Co., 2 W. 33rd St., New York, N. Y.
Specialty Glass Co., 536 Lake Shore Drive, Chicago 11, Ill.
Universal X-Ray Products, Inc., 1140 N. Western Ave., Chicago 22, Ill.
Wakefield Industries, Inc., 5108 Grove St., Skokie, Ill.
Wheaton Co., T. C., Millville, N. J.
Wood Counter Laboratory, N., 5491 Blackstone, Chicago 15, Ill.
Yonkers Laboratory Supply Co., 70 Palisade Ave., Yonkers 2, N. Y.

GLASS VIEWING WINDOWS

Bache & Co., Semon, 636 Greenwich St., New York 14, N. Y.
BAR-RAY PRODUCTS, INC., 209 25th St., Brooklyn 32, N. Y. ADV. PG. 112
Cooper-Hewitt Electric Co., 721 Grand St., Hoboken, N. J.
Corning Glass Works, Corning, N. Y.
Daylight Vacuum Products Co., 5207 N. Milwaukee Ave., Chicago 30, Ill.
PENBERTHY INSTRUMENT CO., HI-D DIVISION, 666 Adams St., Seattle 8, Wash. ADV. PGS. 127, 134
Phoenix Precision Instrument Co., 3803–05 N. 5th St., Philadelphia, Pa.
Radioisotope Application Co., 1843 University Ave., Berkeley 3, Calif.
Scientific Service, Inc., 1417 Solano Ave., Albany, Calif.
Servo Corp. of America, 2020 Jericho Turnpike, New Hyde Park, N. Y.
Tinsley Laboratories, Inc., 2526 Grove St., Berkeley 4, Calif.

GLASSSWARE—Laboratory

Aloe Scientific Div. of A. S. Aloe Co., 5655 Kingsbury Blvd., St. Louis 12, Mo.
Bache & Co., Semon, 636 Greenwich St., New York 14, N. Y.
Central Scientific Co., 1700 Irving Park Rd., Chicago 13, Ill.
Consolidated Siphon Supply Co., Inc., 24 Wooster St., New York, N. Y.
Cooper-Hewitt Electric Co., 721 Grand St., Hoboken, N. J.
Corning Glass Works, Corning, N. Y.
Daylight Vacuum Products Co., 5207 N. Milwaukee Ave., Chicago 30, Ill.
Fischer & Porter Co., 50 County Line Rd., Hatboro, Pa.
Fish-Schurman Corp., 70 Portman Rd., New Rochelle, N. Y.
Fisher Scientific Co., 709 Forbes St., Pittsburgh 19, Pa.
Freed, Inc., J. Melvin, Perkasie, Pa.
Heiligo, Inc., 3718 Northern Blvd., Long Island City 1, N. Y.
Jasonais Chemical Corp., 1085 Myrtle Ave., Brooklyn 6, N. Y.
KONTES GLASS CO., Spruce St., Vineland, N. J. ADV. PG. 126
LEITZ, INC., E., 304 Hudson St. at Spring St., New York 13, N. Y. ADV. PG. 121
Milwaukee Glass Works, Inc., 2338 N. 30th St., Milwaukee, Wis.
Radioisotope Application Co., 1843 University Ave., Berkeley 3, Calif.
Raacher & Betzhold, Inc., 730 N. Franklin St., Chicago 10, Ill.
Sargent & Co., E. H., 4647 W. Foster Ave., Chicago 30, Ill.
Scientific Glass Apparatus Co., Inc., 100 Lakewood Terrace, Bloomfield, N. J.
Scientific Service, Inc., 1417 Solano Ave., Albany, Calif.
Special Glass Products Co., 2 W. 33rd St., New York, N. Y.
Specialty Glass Co., 536 Lake Shore Drive, Chicago 11, Ill.
Thomas Co., Arthur H., W. Washington Square, Philadelphia 5, Pa.
Will Corp., Rochester 3, N. Y.
Wakefield Industries, Inc., 5108 Grove St., Skokie, Ill.
Wood Counter Laboratory, N., 5491 Blackstone, Chicago 15, Ill.
Yonkers Laboratory Supply Co., 70 Palisade Ave., Yonkers 2, N. Y.

GOGGLES—Safety

American Optical Co., Southbridge, Mass.
Bausch & Lomb Optical Co., 630 St. Paul St., Rochester 2, N. Y.
Bullard Co., E. D., 275 Eighth St., San Francisco 3, Calif.
Colloid Equipment Co., Inc., 50 Church St., New York 7, N. Y.
Martindale Electric Co., 1375 Hird Ave., Cleveland 7, Ohio
MINE SAFETY APPLIANCES CO., 201 N. Braddock Ave., Pittsburgh 21, Pa. ADV. PG. 130
Willson Products, Inc., Reading, Pa.

HEATERS—Electric

Acme Electric Heating Co., Inc., 1205 Washington St., Boston, Mass.
Ambory Corp., 21320 Stephenson, Hazel Park, Mich.
American Instrument Corp., Inc., 8030 Georgia Ave., Silver Spring, Md.
American Oxygen Service Corp., 400 Essex St., Harrison, N. J.
Central Scientific Co., 1700 Irving Park Rd., Chicago 13, Ill.
Colloid Equipment Co., Inc., 50 Church St., New York 7, N. Y.
Cutler-Hammer, Inc., 412 N. 12th St., Milwaukee 1, Wis.
Daylight Vacuum Products Co., 5207 N. Milwaukee Ave., Chicago 30, Ill.
Electric Hotpack Co., Inc., 5035 Cottman Ave., Philadelphia, Pa.
Fisher Scientific Co., 709 Forbes St., Pittsburgh 19, Pa.
Ilg Electric Ventilating Co., 2850 N. Crawford Ave., Chicago 41, Ill.
Industrial Engineering & Equipment Co., 711 S. Theresa, St. Louis 3, Mo.
Precision Scientific Co., 3737 W. Cortland St., Chicago 47, Ill.
Vulcan Electric Co., 88 Holten St., Danvers, Mass.
Watlow Electric Mfg. Co., 1376 Ferguson Ave., St. Louis 14, Mo.
Westinghouse Electric Corp., P. O. Box 868, Pittsburgh 30, Pa.
Yonkers Laboratory Supply Co., 70 Palisade Ave., Yonkers 2, N. Y.

HEATERS—Immersion

Acme Electric Heating Co., Inc., 1205 Washington St., Boston, Mass.
Ambory Corp., 21320 Stephenson, Hazel Park, Mich.
American Instrument Co., Inc., 8030 Georgia Ave., Silver Spring, Md.
BAR-RAY PRODUCTS, INC., 209 25th St., Brooklyn 32, N. Y. ADV. PG. 112
Central Scientific Co., 1700 Irving Park Rd., Chicago 13, Ill.
Colloid Equipment Co., Inc., 50 Church St., New York 7, N. Y.
Cutler-Hammer, Inc., 412 N. 12th St., Milwaukee 1, Wis.
Eclipse Fuel Engineering Co., 705 S. Main St., Rockford, Ill.
Electric Hotpack Co., Inc., 5035 Cottman Ave., Philadelphia, Pa.
Fisher Scientific Co., 709 Forbes St., Pittsburgh 19, Pa.
General Ceramics & Steatite Corp., 250 Crows Mill Rd., Keasbey, N. J.
Industrial Engineering & Equipment Co., 711 S. Theresa, St. Louis 3, Mo.
Precision Scientific Co., 3737 W. Cortland St., Chicago 47, Ill.
Vulcan Electric Co., 88 Holten St., Danvers, Mass.
Watlow Electric Mfg. Co., 1376 Ferguson Ave., St. Louis 14, Mo.
Westinghouse Electric Corp., P. O. Box 868, Pittsburgh 30, Pa.
Yonkers Laboratory Supply Co., 70 Palisade Ave., Yonkers 2, N. Y.

HEATERS—Induction, High Frequency

Airmec Laboratories, Ltd., High Wycombe, Buckinghamshire, England
Allis-Chalmers Mfg., 935 S. 70th St., Milwaukee 1, Wis.
Bogue Electric Mfg. Co., 52 Iowa Ave., Paterson 3, N. J.
Electric & Musical Industries, Ltd., Hayes, Middlesex, England
Marion Electrical Instrument Co., 402 Canal St., Manchester, N. H.
Peschel Electronics, Inc., 13 Garden St., New Rochelle, N. Y.
Picker X-Ray Corp., 25 S. Broadway, White Plains, N. Y.
Resdel Engineering, 2351 Riverside Drive, Los Angeles 39, Calif.
Scientific Electric Co., 107–119 Monroe St., Garfield, N. J.
Sierra Electronic Corp., San Carlos, Calif.
Weltronic Co., 19500 W. Eight Mile Rd., Detroit 19, Mich.

HEATERS—Infra Red

Watlow Electric Mfg. Co., 1376 Ferguson Ave., St. Louis 14, Mo.

HOODS—Chemical

Aloe Scientific Div. of A. S. Aloe Co., 5655 Kingsbury Blvd., St. Louis 12, Mo.
BAR-RAY PRODUCTS, INC., 209 25th St., Brooklyn 32, N. Y. ADV. PG. 112
BLICKMAN, INC., S., 7900 Gregory Ave., Weehawken, N. J. ADV. PG. 30
Bullard Co., E. D., 275 Eighth St., San Francisco 3, Calif.

Elmer & Amend Div. of Fisher Scientific Co., 635 Greenwich St., New York, N. Y.
Emerson-Sack-Warner Corp., 150 Dorchester Ave., South Boston 23, Mass.
Fisher Scientific Co., 709 Forbes St., Pittsburgh 19, Pa.
Kewaunee Mfg. Co., 5083 S. Center St., Adrian, Mich.
Laboratory Furniture Co., Inc., P. O. Box 590, Mineola, N. Y.
Metal Products Corp., 48 W. 19th St., Weehawken, N. J.
Pabst Engineering Equipment Co., Inc., Elizabeth, N. J.
Radioisotope Application Co., 1843 University Ave., Berkeley 3, Calif.
Scientific Service, Inc., 1417 Solano Ave., Albany, Calif.
Willson Products, Inc., Reading, Pa.

HOSE—Acid Resisting

Atlantic Metal Hose Co., 123 W. 64th St., New York 23, N. Y.
Consolidated Siphon Supply Co., Inc., 24 Wooster St., New York, N. Y.
Goodrich Co., B. F., Akron, Ohio
Goodyear Tire & Rubber Co., Akron, Ohio
Nubsm Products Corp., 111 Colgate Ave., Buffalo 20, N. Y.
Republic Rubber Division of Lee Rubber & Tire Corp., Youngstown, Ohio
U. S. Rubber Co., 1230 Avenue of the Americas, New York 20, N. Y.
U. S. Stoneware Co., Akron 9, Ohio

HOSE—Metal, Flexible

American Brass Co., Waterbury 20, Conn.
American Vacuum Co., 816 S. Michigan Ave., Chicago, Ill.
Atlantic Metal Hose Co., 123 W. 64th St., New York 23, N. Y.

HOSE—Plastic

Consolidated Siphon Supply Co., Inc., 24 Wooster St., New York, N. Y.
Goodyear Tire & Rubber Co., Akron, Ohio
Irvington Varnish & Insulator Co., 10 Argyle Terrace, Irvington, N. J.
Polymer Corp. of Penna., The, Reading, Pa.
U. S. Rubber Co., 1230 Avenue of the Americas, New York 20, N. Y.
U. S. Stoneware Co., Akron 9, Ohio
Yonkers Laboratory Supply Co., 70 Palisade Ave., Yonkers 2, N. Y.

HOSE—Vacuum, Flexible

American Oxygen Service Corp., 600 Essex St., Harrison, N. J.
American Vacuum Co., 816 S. Michigan Ave., Chicago, Ill.
Atlantic Metal Hose Co., 123 W. 64th St., New York 23, N. Y.
DISTILLATION PRODUCTS INDUSTRIES, A Division of Eastman Kodak Co., Rochester 3, N. Y. ADV. PG. 91
Goodyear Tire & Rubber Co., Akron, Ohio
Martindale Electric Co., 1375 Hird Ave., Cleveland 7, Ohio
Republic Rubber Division of Lee Rubber & Tire Corp., Youngstown, Ohio
STOKES MACHINE CO., F. J., Frankford Station P. O., Philadelphia 20, Pa. ADV. PG. 117
U. S. Rubber Co., 1230 Avenue of the Americas, New York 20, N. Y.
U. S. Stoneware Co., Akron 9, Ohio
Yonkers Laboratory Supply Co., 70 Palisade Ave., Yonkers 2, N. Y.

HOT PLATES

Acme Electric Heating Co., Inc., 1205 Washington St., Boston, Mass.
Ambory Corp., 21320 Stephenson, Hazel Park, Mich.
American Instrument Co., Inc., 8030 Georgia Ave., Silver Spring, Md.
Central Scientific Co., 1700 Irving Park Rd., Chicago 13, Ill.
Fisher Scientific Co., 709 Forbes St., Pittsburgh 19, Pa.
Hevi Duty Electric Co., 4212 W. Highland Blvd., Milwaukee 1, Wis.
Precision Scientific Co., 3737 W. Cortland St., Chicago 47, Ill.
Thermo Electric Mfg. Co., 465 Huff, Dubuque, Ia.
Watlow Electric Mfg. Co., 1376 Ferguson Ave., St. Louis 14, Mo.
Will Corp., Rochester 3, N. Y.
Yonkers Laboratory Supply Co., 70 Palisade Ave., Yonkers 2, N. Y.

HOUSINGS—Metal

Buck Engineering Co., 37-41 Mercy St., Freehold, N. J.
Emerson-Sack-Warner Corp., 150 Dorchester Ave., South Boston 23, Mass.
Falstrom Co., 7 Falstrom Court, Passaic, N. J.
Hallett Mfg. Co., 1601 Florence Ave., Inglewood, Calif.
Pabst Engineering Equipment Co., Inc., Elizabeth, N. J.
South River Metal Products Co., Inc., 377-379 Turnpike, South River, N. J.

HUMIDIFIERS

American Instrument Co., Inc., 8030 Georgia Ave., Silver Spring, Md.
Carrier Corp., 300 S. Geddes St., Syracuse 1, N. Y.
Colloid Equipment Co., Inc., 50 Church St., New York 7, N. Y.
Johnson Service Co., 507 E. Michigan St., Milwaukee 2, Wis.
York Corp, York, Pa.

HYGROMETERS

American Instrument Co., Inc., 8030 Georgia Ave., Silver Spring, Md.
Bristol Co., The, Waterbury 20, Conn.
Central Scientific Co., 1700 Irving Park Rd., Chicago 13, Ill.
Colloid Equipment Co., Inc., 50 Church St., New York 7, N. Y.
Johnson Service Co., 507 E. Michigan St., Milwaukee 2, Wis.
Kahl Scientific Instrument Corp., Box 1166, El Cajon, Calif.
Minneapolis-Honeywell Regulator Co., 2753 Fourth Ave. S., Minneapolis, Minn.
MINNEAPOLIS-HONEYWELL REGULATOR CO., Wayne & Roberts Aves., Philadelphia 44, Pa. ADV. PG. 29
Moeller Instrument Co., 132nd St. & 89th Ave., Richmond Hill 18, N. Y.
Nurnberg Thermometer Co., Inc., 124 Livingston St., Brooklyn 2, N. Y.
Sargent & Co., E. H., 4647 W. Foster Ave., Chicago 30, Ill.
Taylor Instrument Companies, 95 Ames St., Rochester N. Y.
U. S. Gauge Div., American Machine & Metals, Inc., Sellersville, Pa.
Weksler Thermometer Corp., Martinique Bldg., 49 W. 32nd St., New York 1, N. Y.
WESTON ELECTRICAL INSTRUMENT CORP., 614 Frelinghuysen Ave., Newark 5, N. J. ADV. PG. 102
Yonkers Laboratory Supply Co., 70 Palisade Ave., Yonkers 2, N. Y.

INDICATORS—Film Thickness

Baldwin Instrument Co., Ltd., Brooklands Works, Dartford, Kent, England
COLE, LTD., E. K., Electronics Div., Malmesbury, Wiltshire, England. ADV. PG. 29
Electronic Control Corp., 1573 E. Forest St., Detroit 7, Mich.
Foxboro Co., 38 Neponset Ave., Foxboro, Mass.
GENERAL ELECTRIC CO., Apparatus Sales Div., Schenectady 5, N. Y. ADV. PGS. 2-5
Gulton Mfg. Corp., 212 Durham Ave., Metuchen, N. J.
Ohmart Corp., The, 2347 Ferguson Ave., Cincinnati 38, Ohio
Magnaflux Corp., 5900 Northwest Highway, Chicago 31, Ill.
Standard Electronics Research Corp., 2 East End Ave., New York 21, N. Y.
TRACERLAB, INC., 130 High St., Boston 10, Mass. ADV. PG. 24

INDICATORS—Fluid Flow

Automatic Temperature Control Co., Inc., 5206 Pulaski Ave., Philadelphia 44, Pa.
Bristol Co., The, Waterbury 20, Conn.
Brooks Rotameter Co., Box A-1347, Lansdale, Pa.
Eclipse-Pioneer Div., Bendix Aviation Corp., Teterboro, N. J.
Fischer & Porter Co., 50 County Line Rd., Hatboro, Pa.
Foxboro Co., 38 Neponset Ave., Foxboro, Mass.
Gaveco Labs., Inc., 2 East End Ave., New York 21, N. Y.
Gulton Mfg. Corp., 212 Durham Ave., Metuchen, N. J.
Hammel-Dahl Co., 175 Post Rd., (Warwick) Providence 5, R. I.
Hays Corp., Michigan City, Ind.
Imperial Brass Mfg. Co., 1200 W. Harrison St., Chicago 7, Ill.
Inflico, Inc., P. O. Box 5033, Tucson, Ariz.
Kahl Scientific Instrument Corp., Box 1166, El Cajon, Calif.
Minneapolis-Honeywell Regulator Co., 2753 Fourth Ave. S., Minneapolis, Minn.
MINNEAPOLIS-HONEYWELL REGULATOR CO., Wayne & Roberts Aves., Philadelphia 44, Pa. ADV. PG. 29
Precision Scientific Co., 3737 W. Cortland St., Chicago 47, Ill.
Simplex Valve & Meter Co., 68th & Upland Sts., Philadelphia, Pa.
Taylor Instrument Companies, 95 Ames St., Rochester, N. Y.
TRACERLAB, INC., 130 High St., Boston 10, Mass. ADV. PG. 24
U. S. Gauge Div., American Machine & Metals, Inc., Sellersville, Pa.

INDICATORS—Humidity

AERONAUTICAL RESEARCH LABS., GENERAL MILLS, INC., 2010 E. Hennepin Ave., Minneapolis 13, Minn. ADV. PG. 99
American Instrument Co., Inc., 8030 Georgia Ave., Silver Spring, Md.
Automatic Temperature Control Co., Inc., 5206 Pulaski Ave., Philadelphia 44, Pa.
Bristol Co., The, Waterbury 20, Conn.
CAMBRIDGE INSTRUMENT CO., INC., 3786 Grand Central Terminal, New York 17, N. Y. ADV. PG. 123
Colloid Equipment Co., Inc., 50 Church St., New York 7, N. Y.
Cooper Co., D. C., 1467 S. Michigan Ave., Chicago, Ill.
Daylight Vacuum Products Co., 5207 N. Milwaukee Ave., Chicago 30, Ill.
Foxboro Co., 38 Neponset Ave., Foxboro, Mass.
Hill & Co., E. Vernon, 6829 W. Highland Ave., Chicago 31, Ill.
Kahl Scientific Instrument Corp., Box 1166, El Cajon, Calif.
Minneapolis-Honeywell Regulator Co., 2753 Fourth Ave. S., Minneapolis, Minn.
MINNEAPOLIS-HONEYWELL REGULATOR CO., Wayne & Roberts Aves., Philadelphia 44, Pa. ADV. PG. 29
Photoswitch, Inc., 77 Broadway, Cambridge, Mass.
Pittsburgh Lectrodryer Corp., P. O. Box 1766, Pittsburgh, Pa.
Serdex, Inc., 91 Cambridge St., Boston, Mass.
Taylor Instrument Companies, 95 Ames St., Rochester, N. Y.
Thermo Instruments Co., 1265 Old County Rd., Belmont, Calif.
Weksler Thermometer Corp., Martinique Bldg., 49 W. 32nd St., New York 1, N. Y.
WESTON ELECTRICAL INSTRUMENT CORP., 614 Frelinghuysen Ave., Newark 5, N. J. ADV. PG. 102

INDICATORS—Liquid Level

ASSOCIATED VALVE & ENGINEERING CO., 1150 W. Marquette Rd., Chicago 21, Ill. ADV. PG. 132
Automatic Temperature Control Co., Inc., 5206 Pulaski Ave., Philadelphia 44, Pa.
Bogue Electric Mfg. Co., 52 Iowa Ave., Paterson 3, N. J.
Bristol Co., The, Waterbury 20, Conn.
Colloid Equipment Co., Inc., 50 Church St., New York 7, N. Y.
Eclipse-Pioneer Div., Bendix Aviation Corp., Teterboro, N. J.
Electronic Control Corp., 1573 E. Forest St., Detroit 7, Mich.
Fielden Instrument Division, Robertshaw-Fulton Controls Co., 2920 N. 4th St., Philadelphia 33, Pa.
Fischer & Porter Co., 50 County Line Rd., Hatboro, Pa.
Foxboro Co., 38 Neponset Ave., Foxboro, Mass.
Gulton Mfg. Corp., 212 Durham Ave., Metuchen, N. J.
Hammel-Dahl Co., 175 Post Rd., (Warwick) Providence 5, R. I.
Hays Corp., Michigan City, Ind.
Hill & Co., E. Vernon, 6829 W. Highland Ave., Chicago 31, Ill.
Inflico, Inc., P. O. Box 5033, Tucson, Ariz.
Isotope Products Ltd., Davis Rd., P. O. Box 127, Oakville, Ontario, Canada
Kahl Scientific Instrument Corp., Box 1166, El Cajon, Calif.
Lumenite Electric Co., 407 S. Dearborn St., Chicago 5, Ill.
Manning, Maxwell & Moore, Inc., Stratford, Conn.
Minneapolis-Honeywell Regulator Co., 2753 Fourth Ave. S., Minneapolis, Minn.
MINNEAPOLIS-HONEYWELL REGULATOR CO., Wayne & Roberts Aves., Philadelphia 44, Pa. ADV. PG. 29
NUCLEAR RESEARCH & DEVELOPMENT INC., 1094 Sutter Ave., St. Louis, Mo. ADV. PG. 103
Ohmart Corp., The, 2347 Ferguson Ave., Cincinnati 38, Ohio
Simplex Valve & Meter Co., 68th & Upland Sts., Philadelphia 42, Pa.
Taylor Instrument Companies, 95 Ames St., Rochester, N. Y.
Thermo Instruments Co., 1265 Old County Rd., Belmont, Calif.
TRACERLAB, INC., 130 High St., Boston 10, Mass. ADV. PG. 24
U. S. Gauge Div., American Machine & Metals, Inc., Sellersville, Pa.
X-Ray Department of General Electric Co., 4855 Electric Ave., Milwaukee 1, Wis.

INDICATORS—Pressure

American Oxygen Service Corp., 600 Essex St., Harrison, N. J.
Automatic Temperature Control Co., Inc., 5206 Pulaski Ave., Philadelphia 44, Pa.
Bristol Co., The, Waterbury 20, Conn.
Consolidated Engineering Corp., 300 N. Sierra Madre Villa, Pasadena 8, Calif.
DISTILLATION PRODUCTS INDUSTRIES, A Division of Eastman Kodak Co., Rochester 3, N. Y. ADV. PG. 91
Eclipse-Pioneer Div., Bendix Aviation Corp., Teterboro, N. J.
Electro Products Labs., Inc., 4501 N. Ravenswood, Chicago 6, Ill.
Electronic Engineering Associates Ltd., 1040 Brittan Ave., San Carlos, Calif.
Fischer & Porter Co., 50 County Line Rd., Hatboro, Pa.
Foxboro Co., 38 Neponset Ave., Foxboro, Mass.
Gulton Mfg. Corp., 212 Durham Ave., Metuchen, N. J.
Hastings Instrument Co., Super Highway at Pine Ave., Hampton, Va.
Hays Corp., Michigan City, Ind.
Manning, Maxwell & Moore, Inc., Stratford, Conn.
Minneapolis-Honeywell Regulator Co., 2753 Fourth Ave. S., Minneapolis, Minn.
MINNEAPOLIS-HONEYWELL REGULATOR CO., Wayne & Roberts Aves., Philadelphia 44, Pa. ADV. PG. 29
Photocon Research Products, 421 N. Foothill Blvd., Pasadena 7, Calif.
Rahm Instruments, Inc., 12 West Broadway, New York 7, N. Y.
Taylor Instrument Companies, 95 Ames St., Rochester, N. Y.
Trans-Sonics, Inc., Bedford Airport, Bedford, Mass.
Twentieth Century Electronics, Ltd., Dunbar Works, Dunbar St., West Norwood, London, S. E. 27, England
U. S. Gauge Div., American Machine & Metals, Inc., Sellersville, Pa.
Wallace & Tiernan Products, Inc., Belleville 9, N. J.
Weksler Thermometer Corp., Martinique Bldg., 49 W. 32nd St., New York 1, N. Y.

INDICATORS—Radiation

Airmec Laboratories, Ltd., High Wycombe, Buckinghamshire, England
Allied Radio Corp., 833 W. Jackson Blvd., Chicago 7, Ill.
ANTON ELECTRONIC LABS., INC., 1226-38 Flushing Ave., Brooklyn 37, N. Y. ADV. PG. 136
Atomlab, Inc., 489 Fifth Ave., New York 17, N. Y.
Beckman Instruments, Inc., 820 Mission St., South Pasadena 183, Calif.
Bristol Co., The, Waterbury 20, Conn.
CAMBRIDGE INSTRUMENT CO., INC., 3786 Grand Central Terminal, New York 17, N. Y. ADV. PG. 123
Cinema Television Ltd., Worsley Bridge Rd., London, S. E. 26, England
COLE, LTD., E. K., Electronics Div., Malmesbury, Wiltshire, England. ADV. PG. 28
Consolidated Engineering Corp., 300 N. Sierra Madre Villa, Pasadena 8, Calif.
Detectron Co., 5631 Cahuenga Blvd., North Hollywood, Calif.
Douglas Radio Labs., 176 Norfolk Ave., Boston 19, Mass.
El-Tronics, Inc., 2649 N. Howard St., Philadelphia 33, Pa.
Falk & Co., Ltd., M., 5 Victoria St., London, S. W. 1, England
GENERAL ELECTRIC CO., Apparatus Sales Div., Schenectady 5, N. Y. ADV. PGS. 2-5
Measurement Engineering Ltd., Arnprior, Ontario, Canada
Menlo Research Laboratory, Menlo Park, Calif.
Nuclear Development Laboratory, P. O. Box 7034, Kansas City, Mo.
NUCLEAR INSTRUMENT & CHEMICAL CORP., 223 W. Erie St., Chicago 10, Ill. ADV. PG. Back Cover
NUCLEAR RESEARCH CORP., 2563 Grays Ferry Ave., Philadelphia 46, Pa. ADV. PG. 97
NUCLEONIC CO. OF AMERICA, 497 Union St., Brooklyn 31, N. Y. ADV. PG. 112
Ohmart Corp., The, 2347 Ferguson Ave., Cincinnati 38, Ohio
R-C SCIENTIFIC INSTRUMENT CO., 335 Culver Blvd., Playa Del Rey, Calif. ADV. PG. 129
RADIOACTIVE PRODUCTS, INC., 443 W. Congress St., Detroit, Mich. ADV. PG. 8
Radiation Counter Labs., Inc., 1844 W. 21st St., Chicago 8, Ill.
RADIATION INSTRUMENT DEVELOPMENT LAB., 2337 W. 67th St., Chicago 36, Ill. ADV. PG. Inside Back Cover
Samples Machine Co., A. M., 506 N. Central Ave., Knoxville, Tenn.
Servo Corp. of America, 2020 Jericho Turnpike, New Hyde Park, N. Y.
TECHNICAL ASSOCIATES, INC., 140 W. Providencia Ave., Burbank, Calif. ADV. PG. 130
Thwing-Albert Instrument Co., Penn St. & Pulaski Ave., Philadelphia 44, Pa.
TRACERLAB, INC., 130 High St., Boston 10, Mass. ADV. PG. 24
VICTOREEN INSTRUMENT CO., 3800 Perkins Ave., Cleveland 14, Ohio. ADV. PG. Inside Front Cover

INDICATORS—Temperature

Assembly Products, Inc., Chagrin Falls 6, Ohio
BAR-RAY PRODUCTS, INC., 209 25th St., Brooklyn 32, N. Y. ADV. PG. 112
CAMBRIDGE INSTRUMENT CO., INC., 3786 Grand Central Terminal, New York 17, N. Y. ADV. PG. 123
Cole Instrument Co., 1320 S. Grand Ave., Los Angeles 15, Calif.
Colloid Equipment Co., Inc., 50 Church St., New York 7, N. Y.
Edison, Inc., Thomas A., Instrument Div., West Orange, N. J.
Fischer & Porter Co., 50 County Line Rd., Hatboro, Pa.
Fisher Scientific Co., 709 Forbes St., Pittsburgh 19, Pa.
Foxboro Co., 38 Neponset Ave., Foxboro, Mass.
Hays Corp., Michigan City, Ind.
Hill & Co., E. Vernon, 6829 W. Highland Ave., Chicago 31, Ill.
Industrial Controls, Inc., 525 N. Noble St., Chicago 22, Ill.
International Instruments, Inc., P. O. Box 2954, New Haven 15, Conn.
Johnson Service Co., 507 E. Michigan St., Milwaukee 2, Wis.
Kahl Scientific Instrument Corp., Box 1166, El Cajon, Calif.
Leeds & Northrup Co., 4970 Stenton Ave., Philadelphia 44, Pa.
Manning, Maxwell & Moore, Inc., Stratford, Conn.
Marion Electrical Instrument Co., 402 Canal St., Manchester, N. H.
Minneapolis-Honeywell Regulator Co., 2753 Fourth Ave. S., Minneapolis, Minn.
MINNEAPOLIS-HONEYWELL REGULATOR CO., Wayne & Roberts Aves., Philadelphia 44, Pa. ADV. PG. 29
Moeller Instrument Co., 132nd St. and 89th Ave., Richmond Hill, N. Y.
Partlow Corp., The, 2 Campion Rd., New Hartford, N. Y.
Powers Regulator Co., 3400 Oakton, Skokie, Ill.
Pyrometer Instrument Co., Inc., Bergenfield, N. J.
Rubicon Co., Ridge Ave. at 35th St., Philadelphia 32, Pa.
Servo Corp. of America, 2020 Jericho Turnpike, New Hyde Park, N. Y.
Standard Electronics Research Corp., 2 East End Ave., New York 21, N. Y.
Stiefel, Inc., Herman H., 27 Park Place, New York 7, N. Y.
Taco West Corp., 525 N. Noble St., Chicago 22, Ill.
Taylor Instrument Companies, 95 Ames St., Rochester, N. Y.
Thwing-Albert Instrument Co., Penn St., & Pulaski Ave., Philadelphia 44, Pa.
Trans-Sonics, Inc., Bedford Airport, Bedford, Mass.
U. S. Gauge Div., American Machine & Metals, Inc., Sellersville, Pa.
Weksler Thermometer Corp., Martinique Bldg., 49 W. 32nd St., New York 1, N. Y.
WESTON ELECTRICAL INSTRUMENT CORP., 614 Frelinghuysen Ave., Newark 5, N. J. ADV. PG. 102
Wheelco Instruments Co., 847 W. Harrison St., Chicago 7, Ill.
Winslow Co., Inc., 9 Liberty St., Newark, N. J.

INDICATORS—Timing

Airmec Laboratories, Ltd., High Wycombe, Buckinghamshire, England
American Chronoscope Corp., 316 W. First St., Mt. Vernon, N. Y.
Automatic Temperature Control Co., Inc., 5206 Pulaski Ave., Philadelphia 44, Pa.
Berkeley Scientific Div. of Beckman Instruments, 2200 Wright Ave., Richmond, Calif.
Bristol Co., The, Waterbury 20, Conn.
CAMBRIDGE INSTRUMENT CO., INC., 3786 Grand Central Terminal, New York 17, N. Y. ADV. PG. 123
Cinema-Television Ltd., Worsley Bridge Rd., London S. E. 26, England
COLE, LTD., E. K., Electronics Div., Malmesbury, Wiltshire, England. ADV. PG. 28
Colloid Equipment Co., Inc., 50 Church St., New York 7, N. Y.
Computer Research Corp., 3348 W. El Segundo Blvd., Hawthorne, Calif.
Cossor (Canada) Ltd., 301 Windsor St., Halifax, N. S., Canada
Detectron Co., 5631 Cahuenga Blvd., N. Hollywood, Calif.
Doelcam Corp., 56 Elmwood St., Newton, Mass.
Electronic Control Corp., 1573 E. Forest St., Detroit 7, Mich.
Haydon Mfg. Co., Inc., 584 E. Elm St., Torrington, Conn.
Leland Instruments Ltd., 22-23 Millbank, London, S. W. 1, England
Lumenite Electric Co., 407 S. Dearborn St., Chicago 5, Ill.
Photobell Company, 116 Nassau St., New York 7, N. Y.
RADIOACTIVE PRODUCTS, INC., 443 W. Congress St., Detroit, Mich. ADV. PG. 8
Rutherford Electronics Corp., 3707 S. Robertson Blvd., Culver City, Calif.
Standard Electric Time Co., 89 Logan St., Springfield, Mass.
Standard Electronics Research Corp., 2 East End Ave., New York 21, N. Y.
Sun Electric Corp., 6323 Avondale Ave., Chicago 31, Ill.
TRACERLAB, INC., 130 High St., Boston 10, Mass. ADV. PG. 24
U. S. Gauge Div., American Machine & Metals, Inc., Sellersville, Pa.
Vectron, Inc., 400 Main St., Waltham 54, Mass.
Weltronic Co., 19500 W. Eight Mile Rd., Detroit 19, Mich.
Westinghouse Electric Corp., P. O. Box 868, Pittsburgh 30, Pa.

INDICATORS—Vacuum

Automatic Temperature Control Co., Inc., 5206 Pulaski Ave., Philadelphia 44, Pa.
Bristol Co., The, Waterbury 20, Conn.
Central Scientific Co., 1700 Irving Park Rd., Chicago 13, Ill.
Consolidated Engineering Corp., 300 N. Sierra Madre Villa, Pasadena 8, Calif.
Cramer Co., Inc., R. W., Box 13, Centerbrook, Conn.
Daylight Vacuum Products Co., 5207 N. Milwaukee Ave., Chicago 30, Ill.
DISTILLATION PRODUCTS INDUSTRIES, A Division of Eastman Kodak Co., Rochester 3, N. Y. ADV. PG. 91
Douglas Radio Labs., 176 Norfolk Ave., Boston 19, Mass.
Eisler Engineering Co., 760 S. 13th St., Newark 3, N. J.
Electronic Control Corp., 1573 E. Forest St., Detroit 7, Mich.
Foxboro Co., 38 Neponset Ave., Foxboro, Mass.
Fredericks Co., George E., Bethayres, Pa.
GENERAL ELECTRIC CO., Apparatus Sales Div., Schenectady 5, N. Y. ADV. PGS. 2-5
Hastings Instrument Co., Super Highway at Pine Ave., Hampton, Va.
Hays Corp., Michigan City, Ind.
Manning, Maxwell & Moore, Inc., Stratford, Conn.
Minneapolis-Honeywell Regulator Co., 2753 Fourth Ave. S., Minneapolis, Minn.
MINNEAPOLIS-HONEYWELL REGULATOR CO., Wayne & Roberts Aves., Philadelphia 44, Pa. ADV. PG. 29
NATIONAL RESEARCH CORP., 70 Memorial Drive, Cambridge 42, Mass. ADV. PG. 16
OPTICAL FILM ENGINEERING CO., 2731-37 N. 6th St., Philadelphia 33, Pa. ADV. PG. 106
Process & Instruments, 60 Greenpoint Ave., Brooklyn 22, N. Y.
RADIO CORP. OF AMERICA, RCA VICTOR DIV., ENGINEERING PRODUCTS DEPT., Front & Cooper Sts., Camden, N. J. ADV. PG. 13
SCIENTIFIC SPECIALTIES CORP., Snow & Union Sts., Brighton 35, Mass. ADV. PG. 122
STOKES MACHINE CO., F. J., Frankford Station P. O., Philadelphia 20, Pa. ADV. PG. 117
Trans-Sonics, Inc., Bedford Airport, Bedford, Mass.
U. S. Gauge Div., American Machine & Metals, Inc., Sellersville, Pa.
Universal X-Ray Products Inc., 1140 N. Western Ave., Chicago 22, Ill.
Vacuum-Electronic Engineering Co. 86 Denton Ave., New Hyde Park, N. Y.
Wallace & Tiernan Products, Inc., Belleville 9, N. J.
Weksler Thermometer Corp., Martinique Bldg., 49 W. 32nd St., New York 1, N. Y.
Welch Scientific Co., W. M., 1515 Sedgwick St., Chicago 10, Ill.

INSTRUMENT COMPONENTS

Allied Radio Corp., 833 W. Jackson Blvd., Chicago 7, Ill.
American Optical Co., Southbridge, Mass.
Associated Research, Inc., 3788 W. Belmont, Chicago, Ill.
ATOMIC INSTRUMENT CO., 84 Massachusetts Ave., Cambridge 39, Mass. ADV. PG. 23
Barnes Development Co., 213 W. Baltimore Pike, Lansdowne, Pa.
Bristol Co., The, Waterbury 20, Conn.
C. G. S. Laboratories, Inc., 391 Ludlow St., Stamford, Conn.
CENTRAL RESEARCH LABORATORIES, INC., Red Wing, Minn. ADV. PG. 118
Centralab Division of Globe-Union, Inc., 900 E. Keefe Ave., Milwaukee 1, Wis.
Cole Instrument Co., 1320 S. Grand Ave., Los Angeles 15, Calif.

Conoflow Corp., 2100 Arch St., Philadelphia 3, Pa.
Davon Co., 191 Central Ave., Newark 4, N. J.
Edcliff Instruments, 850 S. Fair Oaks Ave., Pasadena, Calif.
Electric Design & Mfg. Corp., Burlington, Iowa
Engineering Research Associates, Inc., 1902 W. Minnehaha Ave., St. Paul 4, Minn.
Ford Instrument Co., 31–10 Thomson Ave., Long Island City, N. Y.
GENERAL ELECTRIC CO., Apparatus Sales Div., Schenectady 5, N. Y. ADV. PGS. 2–5
Insuline Corp. of America, 36–02 35th Ave., Long Island City, N. Y.
K-V Transformer Corp., 20 E. Franklin St., Danbury, Conn.
Kahl Scientific Instrument Corp., Box 1166, El Cajon, Calif.
Librascope, Inc., 1607 Flower St., Glendale 1, Calif.
Mallory & Co., Inc., P. R., 3029 E. Washington St., Indianapolis 6, Ind.
Muirhead & Co., Ltd., Beckenham, Kent, England
Perkin-Elmer Corp., Norwalk, Conn.
Phoenix Precision Instrument Co., 3803–05 N. 5th St., Philadelphia, Pa.
Photocon Research Products, 421 N. Foothill Blvd., Pasadena 7, Calif.
R-C SCIENTIFIC INSTRUMENT CO., 335 Culver Blvd., Playa Del Rey, Calif. ADV. PG. 129
Radioisotope Application Co., 1843 University Ave., Berkeley 3, Calif.
Rubicon Co., Ridge Ave. at 35th St., Philadelphia 32, Pa.
Scientific Service, Inc., 1417 Solano Ave., Albany, Calif.
SERVOMECHANISMS, INC., Post & Stewart Aves., Westbury, N. Y. ADV. PG. 109
Square Root Mfg. Corp., 391 Saw Mill River Rd., Yonkers, N. Y.
Telectro Industries Corp., 35–18 37th St., Long Island City 1, N. Y.
Trans-Sonics, Inc., Bedford Airport, Bedford, Mass.
U. S. GASKET CO., 602 N. 10th St., Camden, N. J. ADV. PG. 135
Vectron, Inc., 400 Main St., Waltham 54, Mass.
Veeder-Root, Inc., 20 Sergeant St., Hartford 2, Conn.
VICTOREEN INSTRUMENT CO., 3800 Perkins Ave., Cleveland 14, Ohio. ADV. PG. Inside Front Cover
Wang Laboratories, 296 Columbus Ave., Boston 16, Mass.
Western Radiation Lab., 1107 W. 24th St., Los Angeles 27, Calif.

INSTRUMENT PARTS—Precision

American Optical Co., Southbridge, Mass.
Applied Physics Corp., 362 W. Colorado St., Pasadena 1, Calif.
Associated Research, Inc. 3788 W. Belmont, Chicago, Ill.
Barnes Development Co., 213 W. Baltimore Pike, Lansdowne, Pa.
Bristol Co., The, Waterbury 20, Conn.
C. G. S. Laboratories, Inc., 391 Ludlow St., Stamford, Conn.
CAMBRIDGE INSTRUMENT CO., INC., 3786 Grand Central Terminal, New York 17, N. Y. ADV. PG. 123
CENTRAL RESEARCH LABORATORIES, INC., Red Wing, Minn. ADV. PG. 118
Chandler & Stedman, 398 Newton St., Waltham 54, Mass.
Cole Instrument Co., 1320 S. Grand Ave., Los Angeles 15, Calif.
Conoflow Corp., 2100 Arch St., Philadelphia 3, Pa.
Cossor (Canada) Ltd., 301 Windsor St., Halifax, N. S., Canada
Edcliff Instruments, 850 S. Fair Oaks Ave., Pasadena, Calif.
Electro-Mec Laboratory, 19 Murray St., New York 7, N. Y.
Ferner Co., R. Y., 110 Pleasant St., Malden, Mass.
Ford Instrument Co., 31–10 Thomson Ave., Long Island City, N. Y.
Foxboro Co., 38 Neponset Ave., Foxboro, Mass.
GENERAL ELECTRIC CO., Apparatus Sales Div., Schenectady 5, N. Y. ADV. PGS. 2–5
Hill & Co., E. Vernon, 6829 W. Highland Ave., Chicago 31, Ill.
Instrument Laboratories, 315 W. Walton Place, Chicago 10, Ill.
Insuline Corp. of America, 36–02 35th Ave., Long Island City, N. Y.
Jarrell-Ash Co., 165 Newberry St., Boston 16, Mass.
Kahl Scientific Instrument Corp. Box 1166, El Cajon, Calif.
Measurement Engineering Ltd., Arnprior, Ontario, Canada
Ney Co., J. M., 71 Elm St., Hartford 1, Conn.
Pitkin Engineering Equipment Co., Inc., Elizabeth, N. J.
Patterson, Moos & Co., Inc., 32–36 47th Ave., Long Island City 1, N. Y.
Perkin-Elmer Corp., Norwalk, Conn.
Phaostron Co., 151 Pasadena Ave. South Pasadena, Calif.
Phoenix Precision Instrument Co., 3803–05 North 5th St., Philadelphia, Pa.
Photocon Research Products, 421 N. Foothill Blvd., Pasadena 7, Calif.
Radioisotope Application Co., 1843 University Ave., Berkeley 3, Calif.
Rubicon Co., Ridge Ave. at 35th St., Philadelphia 32, Pa.
Scientific Service, Inc., 1417 Solano Ave., Albany, Calif.
SERVOMECHANISMS, INC., Post & Stewart Aves., Westbury, N. Y. ADV. PG. 109
Spaulding Fibre Co., Inc., 310 Wheeler St., Tonawanda, N. Y.
U. S. GASKET CO., 602 N. 10th St., Camden, N. J. ADV. PG. 135
U. S. Radium Corp., 535 Pearl St. New York 7, N. Y.
UNITED STATES TESTING CO., Hoboken, N. J. ADV. PG. 114
Vectron, Inc., 400 Main St., Waltham 54, Mass.
VICTOREEN INSTRUMENT CO., 3800 Perkins Avenue, Cleveland 14, Ohio. ADV. PG. Inside Front Cover
Wang Laboratories, 296 Columbus Ave., Boston 16, Mass.

INSULATORS—Ceramic

AMERICAN LAVA CORP., Chattanooga 5, Tenn. ADV. PG. 26
Armstrong Cork Co., 1010 Concord St., Lancaster, Pa.
Centralab Division of Globe-Union, Inc., 900 E. Keefe Ave., Milwaukee 1, Wis.
Coors Porcelain Co., Golden, Colo.
General Ceramics & Steatite Corp., 250 Crows Mill Rd., Keasbey, N. J.
Hermetic Seal Products Co., 29–37 S. 6th St., Newark 7, N. J.
Insuline Corp. of America, 36–02 35th Ave., Long Island City, N. Y.
Kirchberger & Co., Inc., M., 1425 37th St., Brooklyn 18, N. Y.
Lapp Insulator Co., Inc., 31 Gilbert St., LeRoy, N. Y.
Locke Insulator Corp., P. O. Box 57, Baltimore 3, Md.
Louthan Mfg. Co., East Liverpool, Ohio
Porcelain Products, Inc., 422 W. Sandusky St., Findlay, Ohio
Steward Mfg. Co., D. M., East 36th St., Chattanooga 1, Tenn.
STUPAKOFF CERAMIC & MFG. CO., Latrobe, Pa. ADV. PG. 131
THOMPSON CO., H. I., 1733 Cordova St., Los Angeles 7, Calif. ADV. PG. 120
Western Gold & Platinum Works, 589 Bryant St., San Francisco, Calif.

INSULATORS—Fused Quartz

Cooper-Hewitt Electric Co., 721 Grand St., Hoboken, N. J.
Dallons Labs., 5066 Santa Monica Blvd., Los Angeles, Calif.
General Ceramics & Steatite Corp., 250 Crows Mill Rd., Keasbey, N. J.
General Electric Co., Lamp Div., Nela Park, Cleveland 12, Ohio

INSULATORS—Plastic

Biggs Co., Carl H., 11616 W. Pico Blvd., Los Angeles, Calif.
Continental-Diamond Fibre Co., Newark, Delaware
GARDE MFG. CO., 588 Eddy St., Providence, R. I. ADV. PG. 98
General Electric Co., Chemical Div., 1 Plastics Ave., Pittsfield, Mass.
Gits Molding Corp., 4600 W. Huron St., Chicago 44, Ill.
Irvington Varnish & Insulator Co., 6 Argyle Terrace, Irvington, N. J.
Keystone Electronics Corp., 423 Broome St., New York 13, N. Y.
National Vulcanized Fibre Co., Wilmington 99, Del.
Neo-Sil Corp., 26 Carnelian Ave., Jersey City 4, N. J.
Penn Fibre & Specialty Co., 2020 E. Westmoreland St., Philadelphia 34, Pa.
Polymer Corp. of Penna., The, Reading, Pa.
Spaulding Fibre Co., Inc., 310 Wheeler St., Tonawanda, N. Y.
Synthane Corp., River Road, Oaks, Pa.
United Chromium, Inc., 100 E. 42nd St., New York, N. Y.
U. S. GASKET CO., 602 N. 10th St., Camden, N. J. ADV. PG. 135
Westinghouse Electric Corp., P. O. Box 868, Pittsburgh 30, Pa.

ISOTOPE-LABELED COMPOUNDS

Abbott Laboratories, North Chicago, Ill.
ATOMIC ENERGY OF CANADA, LTD., Commercial Products Div., P. O. Box 93, Ottawa, Ontario, Canada. ADV. PG. 18
Atomlab, Inc., 489 Fifth Ave. New York 17, N. Y.
DISTILLATION PRODUCTS INDUSTRIES, A Division of Eastman Kodak Co., Rochester 3, N. Y. ADV. PG. 91
Finkle, Raymond D., 2633 Santa Monica Blvd., Santa Monica, Calif.
ISOTOPE SPECIALTIES CO., 3816 San Fernando Rd., Glendale, Calif. ADV. PG. 94
NUCLEAR INSTRUMENT & CHEMICAL CORP., 223 W. Erie St., Chicago 10, Ill. ADV. PG. Back Cover
NUCLEAR RESEARCH CORP., 2563 Grays Ferry Ave., Philadelphia 46, Pa. ADV. PG. 97
Patterson, Moos & Co., Inc., 32–36 47th Ave., Long Island City 1, N. Y.
RADIOACTIVE PRODUCTS, INC., 443 W. Congress St., Detroit 26, Mich. ADV. PG. 8
TECHNICAL ASSOCIATES, INC., 140 W. Providencia Ave., Burbank, Calif. ADV. PG. 130
TECHNICAL OPERATIONS, INC., 6 Schouler Court, Arlington 74, Mass. ADV. PG. 128
Texas Research Foundation, Renner, Texas
TRACERLAB, INC., 130 High St., Boston 10, Mass. ADV. PG. 24
UNITED STATES TESTING CO., Hoboken, N. J. ADV. PG. 114

ISOTOPES—Radioactive

Abbott Laboratories, North Chicago, Ill.
ANTON ELECTRONIC LABS., INC., 1226–38 Flushing Ave., Brooklyn 37, N. Y. ADV. PG. 136
Atomlab, Inc., 489 Fifth Ave., New York 17, N. Y.
ATOMIC ENERGY OF CANADA, LTD., Commercial Products Div., P. O. Box 93, Ottawa, Ontario, Canada. ADV. PG. 18
Falk & Co., Ltd., M., 5 Victoria St., London, S. W. 1, England
Finkle, Raymond D., 2633 Santa Monica Blvd., Santa Monica, Calif.
Fleischman, Burd & Co., Inc., 22 W. 48th St., New York 19, N. Y.
Isotope Products Ltd., Davis Rd., P. O. Box 127, Oakville, Ontario, Canada
ISOTOPE SPECIALTIES CO., 3816 San Fernando Rd., Glendale, Calif. ADV. PG. 94
Landsverk Electrometer Co., 550–552 W. Garfield Ave., Glendale 4, Calif.
NUCLEAR INSTRUMENT & CHEMICAL CORP., 223 W. Erie St., Chicago 10, Ill. ADV. PG. Back Cover
NUCLEAR RESEARCH CORP., 2563 Grays Ferry Ave., Philadelphia 46, Pa. ADV. PG. 97
NUCLEAR RESEARCH & DEVELOPMENT INC., 1094 Sutter Ave., St. Louis, Mo. ADV. PG. 103
Patterson, Moos & Co., Inc., 32–36 47th Ave., Long Island City 1, N. Y.
R-C SCIENTIFIC INSTRUMENT CO., 335 Culver Blvd., Playa Del Rey, Calif. ADV. PG. 129
RADIOACTIVE PRODUCTS, INC., 443 W. Congress St., Detroit 26, Mich. ADV. PG. 8
Radium Chemical Co., 161 E. 42nd St., New York 17, N. Y.
St. John X-Ray Laboratory, Califon, N. J.
TECHNICAL ASSOCIATES, INC., 140 W. Providencia Ave., Burbank, Calif. ADV. PG. 130
TECHNICAL OPERATIONS, INC., 6 Schouler Court, Arlington 74, Mass. ADV. PG. 128
TRACERLAB INC., 130 High St., Boston 10, Mass. ADV. PG. 24
U. S. Radium Corp., 535 Pearl St., New York 7, N. Y.
UNITED STATES TESTING CO., Hoboken, N. J. ADV. PG. 114

ISOTOPES—Stable

Atomlab, Inc., 489 Fifth Ave., New York 17, N. Y.
DISTILLATION PRODUCTS INDUSTRIES, A Division of Eastman Kodak Co., Rochester 3, N. Y. ADV. PG. 91
Patterson, Moos & Co., 32–36 47th Ave., Long Island City 1, N. Y.
TECHNICAL OPERATIONS, INC., 6 Schouler Court, Arlington 74, Mass. ADV. PG. 128
TRACERLAB INC., 130 High St., Boston 10, Mass. ADV. PG. 24

LABORATORIES—Testing & Consulting

Armour Research Foundation, 35 W. 33rd St., Chicago, Ill.
Battelle Memorial Institute, Columbus, Ohio
Cook Research Labs., Div. Cook Electric Co., 1457 Diversey Parkway, Chicago 14, Ill.
Electrical Testing Laboratories, East End Ave. & 79th St., New York, N. Y.
Inland Testing Labs., Div. Cook Electric Co., 2700 Southport, Chicago 14, Ill.
Magnaflux Corp., 5900 Northwest Highway, Chicago 31, Ill.
New York Testing Laboratories, Inc., 80 Washington St., New York 6, N. Y.
NUCLEAR DEVELOPMENT ASSOCIATES, INC., 80 Grand St., White Plains, N. Y. ADV. PG. 110
Tour & Co., Inc., Sam, 44 Trinity Place, New York, N. Y.
TRACERLAB, INC., 130 High St., Boston 10, Mass. ADV. PG. 24
UNITED STATES TESTING CO., INC., Hoboken, N. J. ADV. PG. 114
Vitro Corp. of America, 233 Broadway, New York 7, N. Y.

LAMPS—Mercury Discharge

Cooper-Hewitt Electric Co., 721 Grand St., Hoboken, N. J.
Daylight Vacuum Products Co., 5207 N. Milwaukee Ave., Chicago 30, Ill.
Ferner Co., R. Y., 110 Pleasant St., Malden, Mass.
General Electric Co., Lamp Div., Nela Park Cleveland 12, Ohio
Hanovia Chemical & Mfg. Co., 233 N. J. R. R. Ave., Newark 5, N. J.
Huggins Laboratories, 734 Hamilton Ave., Menlo Park, Calif.
Jarrell-Ash Co., 165 Newberry St., Boston 16, Mass.
Maurer, Inc., J. A., 37–01 31st St., Long Island City, N. Y.
Menlo Research Laboratory, Menlo Park, Calif.
Mico Instrument Co., 80 Trowbridge St., Cambridge 38, Mass.
Phoenix Precision Instrument Co., 3803–05 N. 5th St., Philadelphia, Pa.

LAMPS—Microscope

American Optical Co., Instrument Div., Buffalo 15, N. Y.
Central Scientific Co., 1700 Irving Park Rd., Chicago 13, Ill.
Ferner Co., R. Y., 110 Pleasant St., Malden, Mass.
General Electric Co., Lamp Div., Nela Park, Cleveland 12, Ohio
Heinicke Instruments, 2035 Harding St., Hollywood, Fla.
Jarrell-Ash Co., 165 Newberry St., Boston 16, Mass.

LAMPS—Neon Glow

Allied Radio Corp., 833 W. Jackson Blvd., Chicago 7, Ill.
Chatham Electronics Corp., 475 Washington St., Newark 2, N. J.
Daylight Vacuum Products Co., 5207 N. Milwaukee Ave., Chicago 30, Ill.
General Electric Co., Lamp Div., Nela Park, Cleveland 12, Ohio
Industrial Devices, Inc., 22 State Rd., Edgewater, N. J.
Jarrell-Ash Co., 165 Newberry St., Boston 16, Mass.

LAMPS—Sodium Arc

Daylight Vacuum Products Co., 5207 N. Milwaukee Ave., Chicago 30, Ill.
Goertner Scientific Corp., 1237 Wrightwood Ave., Chicago, Ill.
General Electric Co., Lamp Div., Nela Park, Cleveland 12, Ohio
Jarrell-Ash Co., 165 Newberry St., Boston 16, Mass.
Phoenix Precision Instrument Co., 3803–05 North 5th St., Philadelphia, Pa.

LAMPS—Ultraviolet

Central Scientific Co., 1700 Irving Park Rd., Chicago 13, Ill.
Cooper-Hewitt Electric Co., 721 Grand St., Hoboken, N. J.
Daylight Vacuum Products Co., 5207 N. Milwaukee Ave., Chicago 30, Ill.
Ferner Co., R. Y., 110 Pleasant St., Malden, Mass.
General Electric Co., Lamp Div., Nela Park, Cleveland 12, Ohio
Hanovia Chemical & Mfg. Co., 233 N. J. R. R. Ave., Newark 5, N. J.
Huggins Laboratories, 734 Hamilton Ave., Menlo Park, Calif.
Jarrell-Ash Co., 165 Newberry St., Boston 16, Mass.
Magnaflux Corp., 5900 Northwest Highway, Chicago 31, Ill.
Maurer, Inc., J. A., 37–01 31st St., Long Island City, N. Y.
Menlo Research Laboratory, Menlo Park, Calif.
Mico Instrument Co., 80 Trowbridge St., Cambridge 38, Mass.
Phoenix Precision Instrument Co., 3803–05 North 5th St., Philadelphia, Pa.
Radioisotope Application Co., 1843 University Ave., Berkeley 3, Calif.
Scientific Service, Inc., 1417 Solano Ave., Albany, Calif.
Sylvania Electric Products, Inc., 1740 Broadway, New York 19, N. Y.
Yonkers Laboratory Supply Co., 70 Palisade Ave., Yonkers 2, N. Y.

LEAK TESTERS

Consolidated Engineering Corp., 300 N. Sierra Madre Villa, Pasadena 8, Calif.
Daylight Vacuum Products Co., 5207 N. Milwaukee Ave., Chicago 30, Ill.
DISTILLATION PRODUCTS INDUSTRIES, A Division of Eastman Kodak Co., Rochester 3, N. Y. ADV. PG. 91
GENERAL ELECTRIC CO., Apparatus Sales Div., Schenectady 5, N. Y. ADV. PGS. 2–5
Highside Chemicals Co., 10 Colfax Ave., Clifton, N. J.
Heltzer-Cabot Div. of National Pneumatic Co., 130 Amory St., Boston 19, Mass.
Linick Chemical Co., 59 E. Madison St., Chicago 3, Ill.
Magnaflux Corp., 5900 Northwest Highway, Chicago 31, Ill.
R-C SCIENTIFIC INSTRUMENT CO., 335 Culver Blvd., Playa Del Rey, Calif. ADV. PG. 129
RADIO CORP. OF AMERICA, RCA VICTOR DIV., ENGINEERING PRODUCTS DEPT., Front & Cooper Sts., Camden, N. J. ADV. PG. 13
Sticht, Inc., Herman H., 27 Park Place, New York 7, N. Y.
Vacuum-Electronic Engineering Co., 86 Denton Ave., New Hyde Park, N. Y.

LIGHTS—Monochromatic

Central Scientific Co., 1700 Irving Park Rd., Chicago 13, Ill.
Crane Packing Co., 1800 Cuyler Ave., Chicago 13, Ill.
Ferner Co., R. Y., 110 Pleasant St., Malden, Mass.
Goertner Scientific Corp., 1237 Wrightwood Ave., Chicago, Ill.
General Electric Co., Lamp Div., Nela Park, Cleveland 12, Ohio
Industrial Controls, Inc., 525 N. Noble St., Chicago 22, Ill.
Jarrell-Ash Co., 165 Newberry St., Boston 16, Mass.
LEITZ, INC., E., 304 Hudson St. at Spring St., New York 13, N. Y. ADV. PG. 121
Mico Instrument Co., 80 Trowbridge St., Cambridge 38, Mass.
Phoenix Precision Instrument Co., 3803–05 North 5th St., Philadelphia, Pa.

LIQUIFIERS—Helium

LITTLE, INC., ARTHUR D., Cambridge 42, Mass. ADV. PG. 111

MAGNETS

Arnold Engineering Co., Marengo, Ill.
Carbology Department of General Electric Co., 11139 East Eight Mile Blvd., Detroit 32, Mich.
Cutler-Hammer Inc., 412 N. 12th St., Milwaukee 1, Wis.
Daylight Vacuum Products Co., 5207 N. Milwaukee Ave., Chicago 30, Ill.
Georator Corp., 1820 N. Nash St., Arlington, Va.
Indiana Steel Products Co., 700 Valparaiso St., Valparaiso, Ind.
LITTLE, INC., ARTHUR D., Cambridge 42, Mass. ADV. PG. 111
Mullard Overseas Ltd., Century House, Shaftesbury Ave., London W. C. 2, England
Process & Instruments, 60 Greenpoint Ave., Brooklyn 22, N. Y.
U. S. Steel Co., 525 Wm. Penn Bldg., Pittsburgh 30, Pa.
Varian Associates, 990 Varian St., San Carlos, Calif.

MANIPULATORS

AERONAUTICAL RESEARCH LABS., GENERAL MILLS, INC., 2010 E. Hennepin Ave., Minneapolis 13, Minn. ADV. PG. 99
Air Associates Inc., Teterboro, N. J.
Aloe Scientific Div. of A. S. Aloe Co., 5655 Kingsbury Blvd., St. Louis 12, Mo.
CENTRAL RESEARCH LABORATORIES, INC., Red Wing, Minn. ADV. PG. 118
Falk & Co., Ltd., M., 5 Victoria St., London, S. W. 1, England
Industrial Science Associates, 542 Fifth Ave., New York 19, N. Y.
Process & Instruments, 60 Greenpoint Ave., Brooklyn 22, N. Y.
Radioisotope Application Co., 1843 University Ave., Berkeley 3, Calif.
Scientific Service, Inc., 1417 Solano Ave., Albany, Calif.
TECHNICAL OPERATIONS, INC., 6 Schouler Court, Arlington 74, Mass. ADV. PG. 128

MANOMETERS

Bethlehem Apparatus Co., Inc., Front & Depot Sts., Hellertown, Pa.
Bristol Co., The, Waterbury 20, Conn.
Builders-Providence, Inc., P. O. Box 1342, Providence 1, R. I.
CAMBRIDGE INSTRUMENT CO., INC., 3786 Grand Central Terminal, New York 17, N. Y. ADV. PG. 123
Corning Glass Works, Corning, N. Y.
Daylight Vacuum Products Co., 5207 N. Milwaukee Ave., Chicago 30, Ill.
Fischer & Porter Co., 50 County Line Rd., Hatboro, Pa.
Fisher Scientific Co., 709 Forbes St., Pittsburgh 19, Pa.
Hill & Co., E. Vernon, 6829 W. Highland Ave., Chicago 31, Ill.
Inficon, Inc., P. O. Box 5033, Tucson, Ariz.
Manning, Maxwell & Moore, Inc., Stratford, Conn.
Phipps & Bird, Inc., 303 S. 6th St., Richmond 5, Va.
Phoenix Precision Instrument Co., 3803–05 North 5th St., Philadelphia, Pa.
Precision Scientific Co., 3737 W. Cortland St., Chicago 47, Ill.
Radioisotope Application Co., 1843 University Ave., Berkeley 3, Calif.
Sargent & Co., E. H., 4647 W. Foster Ave., Chicago 30, Ill.
Scientific Glass Apparatus Co., Inc., 100 Lakewood Terrace, Bloomfield, N. J.
Scientific Service, Inc., 1417 Solano Ave., Albany, Calif.
Simplex Valve & Meter Co., 68th & Upland Sts., Philadelphia 42, Pa.
Taylor Instrument Companies, 95 Ames St., Rochester, N. Y.
Thermo Instrument Co., 1265 Old County Rd., Belmont, Calif.
Wallace & Tiernan Products, Inc., Belleville 9, N. J.
Welch Scientific Co., W. M., 1515 Sedgwick St., Chicago 10, Ill.

MANOMETERS—U-Type

Central Scientific Co., 1700 Irving Park Rd., Chicago 13, Ill.
Daylight Vacuum Products Co., 5207 N. Milwaukee Ave., Chicago 30, Ill.
Fredericks Co., George E., Bethayres, Pa.
Gorrell & Gorrell, Haworth, N. J.
Inficon, Inc., P. O. Box 5033, Tucson, Ariz.
KONTES GLASS CO., Spruce St., Vineland, N. J. ADV. PG. 126
Manning, Maxwell & Moore, Inc., Stratford, Conn.
Phipps & Bird, Inc., 303 S. 6th St., Richmond 5, Va.
Phoenix Precision Instrument Co., 3803–05 North 5th St., Philadelphia, Pa.
Precision Scientific Co., 3737 W. Cortland St., Chicago 47, Ill.
Sargent & Co., E. H., 4647 W. Foster Ave., Chicago 30, Ill.
Scientific Glass Apparatus Co., Inc., 100 Lakewood Terrace, Bloomfield, N. J.
Simplex Valve & Meter Co., 68th & Upland Sts., Philadelphia 42, Pa.
Taylor Instrument Companies, 95 Ames St., Rochester, N. Y.
Thermo Instrument Co., 1265 Old County Rd., Belmont, Calif.
Welch Scientific Co., W. M., 1515 Sedgwick St., Chicago 10, Ill.

MANTLES—Heating

Daylight Vacuum Products Co., 5207 N. Milwaukee Ave., Chicago 30, Ill.
Electric Hotpack Co., Inc., 5035 Cottman Ave., Philadelphia, Pa.
Scientific Glass Apparatus Co., Inc., 100 Lakewood Terrace, Bloomfield, N. J.
Yonkers Laboratory Supply Co., 70 Palisade Ave., Yonkers 2, N. Y.

MARKERS—Object, Micro

Daylight Vacuum Products Co., 5207 N. Milwaukee Ave., Chicago 30, Ill.

MASKS—Dust, Fume, Gas, Smoke, etc.

American Optical Co., Southbridge, Mass.
American Oxygen Service Corp., 600 Essex St., Harrison, N. J.
Bullard Co., E. D., 275 Eighth St., San Francisco 3, Calif.
Davis Emergency Equipment Co., Inc., 252 Halleck St., Newark, N. J.
De Vilbiss Co., 300 Phillips Ave., Toledo, Ohio
Martindale Electric Co., 1375 Hird Ave., Cleveland 7, Ohio
MINE SAFETY APPLIANCES CO., 201 N. Braddock Ave., Pittsburgh 21, Pa. ADV. PG. 130
Willson Products, Inc., Reading, Pa.

MEGOHMMETERS

Associated Research, Inc., 3768 W. Belmont, Chicago, Ill.
Atomlab, Inc., 489 Fifth Ave., New York 17, N. Y.
Baldwin Instrument Co., Ltd., Broadlands Works, Dartford, Kent, England
BETA ELECTRIC CORP., 333 E. 103rd St., New York 29, N. Y. ADV. PG. 120
Cole Instrument Co., 1320 S. Grand Ave., Los Angeles 15, Calif.
COLE, LTD., E. K., Electronics Div., Malmesbury, Wiltshire, England. ADV. PG. 26
Dice Co., J. W., Englewood, N. J.
Douglas Radio Labs., 176 Norfolk Ave., Boston 19, Mass.
Electrodyne Co., 32 Oliver St., Boston, Mass.
El-Tronics, Inc., 2649 N. Howard St., Philadelphia 33, Pa.
Feiler Engineering & Mfg. Co., 6026 N. Monticello Ave., Skokie, Ill.
Freed Transformer Co., Inc., 1736 Weirfield St., Brooklyn 27, N. Y.

General Radio Co., 275 Massachusetts Ave., Cambridge 39, Mass.
Hivolt Ltd., 34A Pottery Lane, London W. 11, England
Industrial Instruments, Inc., 89 Commerce Rd., Cedar Grove, N. J.
Keithley Instruments, 3868 Carnegie Ave., Cleveland, Ohio
Martindale Electric Co., 1375 Hird Ave., Cleveland 7, Ohio
MacLeod & Hanopol, Inc., 10 Roland St., Charlestown 29, Mass.
Radio City Products Co., Inc., 152 W. 25th St., New York 1, N. Y.
Square Root Mfg. Corp., 391 Saw Mill River Rd., Yonkers, N. Y.
Sticht, Inc., Herman H., 27 Park Place, New York 7, N. Y.
Triplett Electrical Instrument Co., 286 Harmon Rd., Bluffton, Ohio
VICTOREEN INSTRUMENT CO., 3800 Perkins Ave., Cleveland 14, Ohio. ADV. PG. Inside Front Cover
Western Radiation Lab., 1107 W. 24th St., Los Angeles 27, Calif.
WESTON ELECTRICAL INSTRUMENT CORP., 614 Frelinghuysen Ave., Newark 5, N. J. ADV. PG. 102
Weston Laboratories, Weston 93, Mass.
Winslow Co., Inc., 9 Liberty St., Newark, N. J.

METALLOSCOPES

Bausch & Lomb Optical Co., 630 St. Paul St., Rochester 2, N. Y.
Forner Co., R. Y., 110 Pleasant St., Malden, Mass.
Jarrell-Ash Co., 165 Newberry St., Boston 16, Mass.
PRECISION RADIATION INSTRUMENTS, 2235 S. LaBrea Ave., Los Angeles 16, Calif. ADV. PG. 108

METALS

Alnico

Arnold Engineering Co., Marengo, Ill.

Aluminum

Aluminum Co. of America, 801 Gulf Bldg., Pittsburgh, Pa.
American Oxygen Service Corp., 600 Essex St., Harrison, N. J.
American Silver Co., 36-07 Prince St., Flushing, N. Y.
American Smelting & Refining Co., 120 Broadway, New York 5, N. Y.
Belmont Smelting & Refining Works, Inc., 322 Belmont Ave., Brooklyn, N. Y.
Federated Metals Div., American Smelting & Refining Co., 120 Broadway, New York 5, N. Y.
Hommel Co., O., 209-213 Fourth Ave., Pittsburgh, Pa.
Revere Copper & Brass, Inc., 230 Park Ave., New York 17, N. Y.

Antimony

Alpha Metals, Inc., P. O. Box 34, 56 Water St., Jersey City, N. J.
American Smelting & Refining Co., 120 Broadway, New York 5, N. Y.
Belmont Smelting & Refining Works, Inc., 322 Belmont Ave., Brooklyn, N. Y.
Division Lead Co., 836 W. Kinzie St., Chicago 22, Ill.
Federated Metals Div., American Smelting & Refining Co., 120 Broadway, New York 5, N. Y.
Hommel Co., O., 209-213 Fourth Ave., Pittsburgh, Pa.
Jarrell-Ash Co., 165 Newberry St., Boston 16, Mass.
National Lead Co., 111 Broadway, New York 6, N. Y.

Arsenic

American Smelting & Refining Co., 120 Broadway, New York 5, N. Y.
Belmont Smelting & Refining Works, Inc., 322 Belmont Ave., Brooklyn, N. Y.
Division Lead Co., 836 W. Kinzie St., Chicago 22, Ill.

Barium

Jarrell-Ash Co., 165 Newberry St., Boston 16, Mass.

Beryllium and Beryllium Alloys

American Silver Co., 36-07 Prince St., Flushing, N. Y.
Belmont Smelting & Refining Works, Inc., 322 Belmont Ave., Brooklyn, N. Y.
Beryllium Corp., Reading, Pa.
Brush Beryllium Co., The, 4301 Perkins Ave., Cleveland 3, Ohio

Bismuth

Cerro de Pasco Corp., 40 Wall St., New York 5, N. Y.

Brass and Bronze

American Brass Co., Waterbury 20, Conn.
American Oxygen Service Corp., 600 Essex St., Harrison, N. J.
American Silver Co., 36-07 Prince St., Flushing, N. Y.
American Smelting & Refining Co., 120 Broadway, New York 5, N. Y.
Belmont Smelting & Refining Works, Inc., 322 Belmont Ave., Brooklyn, N. Y.
Bridgeport Brass Co., 30 Grand St., Bridgeport 2, Conn.
Federated Metals Div., American Smelting & Refining Co., 120 Broadway, New York 5, N. Y.
Mallory & Co., Inc., P. R., 3029 E. Washington St., Indianapolis 6, Ind.
Phelps Dodge Refining Corp., 40 Wall St., New York 5, N. Y.
Revere Copper & Brass, Inc., 230 Park Ave., New York 17, N. Y.

Cadmium

American Smelting & Refining Co., 120 Broadway, New York 5, N. Y.
Belmont Smelting & Refining Works, Inc., 322 Belmont Ave., Brooklyn, N. Y.
Division Lead Co., 836 W. Kinzie St., Chicago 22, Ill.
Federated Metals Div., American Smelting & Refining Co., 120 Broadway, New York 5, N. Y.
Hommel Co., O., 209-213 Fourth Ave., Pittsburgh, Pa.
Jarrell-Ash Co., 165 Newberry St., Boston 16, Mass.

Cerium

Belmont Smelting & Refining Works, Inc., 322 Belmont Ave., Brooklyn, N. Y.
Jarrell-Ash Co., 165 Newberry St., Boston 16, Mass.

Chromium

Belmont Smelting & Refining Works, Inc., 322 Belmont Ave., Brooklyn, N. Y.
Electro Metallurgical Co., Div. of Union Carbide & Carbon Corp., 30 E. 42nd St., New York 17, N. Y.
Hommel Co., O., 209-213 Fourth Ave., Pittsburgh, Pa.
Vacuum Metals, Inc., 70 Memorial Drive, Cambridge 42, Mass.

Coefficient Metals

Alloy Tube Division of Carpenter Steel Co., Union, N. J.
American Silver Co., 36-07 Prince St., Flushing, N. Y.
Belmont Smelting & Refining Works, Inc., 322 Belmont Ave., Brooklyn, N. Y.
Carpenter Steel Co., The, Reading, Pa.
Driver-Harris Co., Harrison, N. J.
Vacuum Metals, Inc., 70 Memorial Drive, Cambridge 42, Mass.

Columbium

Electro Metallurgical Co., Div. of Union Carbide & Carbon Corp., 30 E. 42nd St., New York 17, N. Y.
Jarrell-Ash Co., 165 Newberry St., Boston 16, Mass.

Copper

American Brass Co., Waterbury 20, Conn.
American Silver Co., 36-07 Prince St., Flushing, N. Y.
American Smelting & Refining Co., 120 Broadway, New York 5, N. Y.
Belmont Smelting & Refining Works, Inc., 322 Belmont Ave., Brooklyn, N. Y.
Bridgeport Brass Co., 30 Grand St., Bridgeport 2, Conn.
Federated Metals Div., American Smelting & Refining Co., 120 Broadway, New York 5, N. Y.
Hommel Co., O., 209-213 Fourth Ave., Pittsburgh, Pa.
Mallory & Co., Inc., P. R., 3029 E. Washington St., Indianapolis 6, Ind.
Phelps Dodge Refining Corp., 40 Wall St., New York 5, N. Y.
Revere Copper & Brass, Inc., 230 Park Ave., New York 17, N. Y.
Vacuum Metals, Inc., 70 Memorial Drive, Cambridge 42, Mass.

Foil

Alpha Metals, Inc., P. O. Box 34, 56 Water St., Jersey City, N. J.
Aluminum Co. of America, 801 Gulf Bldg., Pittsburgh, Pa.
American Silver Co., 36-07 Prince St., Flushing, N. Y.
BAR-RAY PRODUCTS, INC., 209 25th St., Brooklyn 32, N. Y. ADV. PG. 112
Belmont Smelting & Refining Works, Inc., 322 Belmont Ave., Brooklyn, N. Y.
Bishop & Co., J., Malvern, Pa.
Cross Co., H., 15 Beekman St., New York 7, N. Y.
Division Lead Co., 836 W. Kinzie St., Chicago 22, Ill.
Hommel Co., O., 209-213 Fourth Ave., Pittsburgh, Pa.
Jarrell-Ash Co., 165 Newberry St., Boston 16, Mass.
Yonkers Laboratory Supply Co., 70 Palisade Ave., Yonkers 2, N. Y.

Gallium

Aluminum Co. of America, 801 Gulf Bldg., Pittsburgh, Pa.
Belmont Smelting & Refining Works, Inc., 322 Belmont Ave., Brooklyn, N. Y.
Jarrell-Ash Co., 165 Newberry St., Boston 16, Mass.

Germanium

Belmont Smelting & Refining Works, Inc., 322 Belmont Ave., Brooklyn, N. Y.
Jarrell-Ash Co., 165 Newberry St., Boston 16, Mass.
Sylvania Electric Products, Inc., 1740 Broadway, New York 19, N. Y.

Gold and Gold Alloys

American Silver Co., 36-07 Prince St., Flushing, N. Y.
Baker & Co., Inc., 113 Astor St., Newark 5, N. J.
Bishop & Co., J., Malvern Pa.
Handy & Harman, 82 Fulton St., New York 38, N. Y.
Hill Co., C. R., 35 W. Grand River, Detroit 26, Mich.
Hommel Co., O., 209-213 Fourth Ave., Pittsburgh, Pa.
Linick Chemical Co., 59 E. Madison St., Chicago 3, Ill.
Makepeace Co., D. E., Attleboro, Mass.
Mallory & Co., Inc., P. R., 3029 E. Washington St., Indianapolis 6, Ind.
May Co., J. M., 71 Elm St., Hartford 1, Conn.
Western Gold & Platinum Works, 589 Bryant St., San Francisco, Calif.

High Permeability Alloys

Allegheny Ludlum Steel Corp., 2020 Oliver Bldg., Pittsburgh 22, Pa.
Alloy Metal Wire Co., 13th & Pennsylvania Ave., Prospect Park, Pa.
Alloy Tube Division of Carpenter Steel Co., Union, N. J.
American Silver Co., 36-07 Prince St., Flushing, N. Y.
Arnold Engineering Co., Marengo, Ill.
Carpenter Steel Co., The, Reading, Pa.
Driver-Harris Co., Harrison, N. J.
U. S. Steel Co., 525 Wm. Penn Bldg., Pittsburgh 30, Pa.
Westinghouse Electric Corp., P. O. Box 868, Pittsburgh 30, Pa.

Indium

Cerro de Pasco Corp., 40 Wall St., New York 5, N. Y.

Laminated Metal Products

Allegheny Ludlum Steel Corp., 2020 Oliver Bldg., Pittsburgh 22, Pa.
American Silver Co., 36-07 Prince St., Flushing, N. Y.
BAR-RAY PRODUCTS, INC., 209 25th St., Brooklyn 32, N. Y. ADV. PG. 112
Bishop & Co., J., Malvern, Pa.
Division Lead Co., 836 W. Kinzie St., Chicago 22, Ill.
Makepeace Co., D. E., Attleboro, Mass.

Lead and Lead Alloys

Alpha Metals Inc., P. O. Box 34, 56 Water St., Jersey City, N. J.
American Smelting & Refining Co., 120 Broadway, New York 5, N. Y.
Atomlab, Inc., 489 Fifth Ave., New York 17, N. Y.
BAR-RAY PRODUCTS, INC., 209 25th St., Brooklyn 32, N. Y. ADV. PG. 112
Belmont Smelting & Refining Works, Inc., 322 Belmont Ave., Brooklyn, N. Y.
Division Lead Co., 836 W. Kinzie St., Chicago 22, Ill.
Federated Metals Div., American Smelting & Refining Co., 120 Broadway, New York 5, N. Y.
Hommel Co., O., 209-213 Fourth Ave., Pittsburgh, Pa.
National Lead Co., 111 Broadway, New York 6, N. Y.

Magnesium

Aluminum Co. of America, 801 Gulf Bldg., Pittsburgh, Pa.
American Silver Co., 36-07 Prince St., Flushing, N. Y.
American Smelting & Refining Co., 120 Broadway, New York 5, N. Y.
Belmont Smelting & Refining Works, Inc., 322 Belmont Ave., Brooklyn, N. Y.
Dow Chemical Co., Midland, Mich.
Federated Metals Div., American Smelting & Refining Co., 120 Broadway, New York 5, N. Y.
Jarrel-Ash Co., 165 Newberry St., Boston 16, Mass.

Manganese

Belmont Smelting & Refining Works, Inc., 322 Belmont Ave., Brooklyn, N. Y.
Electro Metallurgical Co., Div. of Union Carbide & Carbon Corp., 30 E. 42nd St., New York 17, N. Y.
Jarrell-Ash Co., 165 Newberry St., Boston 16, Mass.

Mercury

Belmont Smelting & Refining Works, Inc., 322 Belmont Ave., Brooklyn, N. Y.
Daylight Vacuum Products Co., 5207 N. Milwaukee Ave., Chicago 30, Ill.
Division Lead Co., 836 W. Kinzie St., Chicago 22, Ill.
Hill, Co., C. R., 35 W. Grand River, Detroit 26, Mich.
Hommel Co., O., 209–213 Fourth Ave., Pittsburgh, Pa.
Mallinckrodt Chemical Works, Second & Mallinckrodt Sts., St. Louis 7, Mo.
Western Gold & Platinum Works, 589 Bryant St., San Francisco, Calif.
Yonkers Laboratory Supply Co., 70 Palisade Ave., Yonkers 2, N. Y.

Molybdenum

American Silver Co., 36–07 Prince St., Flushing, N. Y.
Belmont Smelting & Refining Works, Inc., 322 Belmont Ave., Brooklyn, N. Y.
Cross Co., H., 15 Beekman St., New York 7, N. Y.
Jarrell-Ash Co., 165 Newberry St., Boston 16, Mass.
Sylvania Electric Products, Inc., 1740 Broadway, New York 19, N. Y.

Nickel and Nickel Alloys

Allegheny Ludlum Steel Corp., 2020 Oliver Bldg., Pittsburgh 22, Pa.
Alloy Metal Wire Co., 13th & Pennsylvania Ave., Prospect Park, Pa.
Alloy Tube Division of Carpenter Steel Co., Union, N. J.
American Silver Co., 36–07 Prince St., Flushing, N. Y.
Astell & Co., John B., 90 W. Broadway, New York 7, N. Y.
Belmont Smelting & Refining Works, Inc., 322 Belmont Ave., Brooklyn, N. Y.
Bishop & Co., J., Malvern, Pa.
Carpenter Steel Co., The, Reading, Pa.
Driver-Harris Co., Harrison, N. J.
Haynes Stellite Co., Div. of Union Carbide & Carbon Corp., Kokomo, Ind.
International Nickel Co., Inc., 67 Wall St., New York 5, N. Y.
Jelliff Mfg. Corp., C. O., 122 Pequot Ave., Southport, Conn.
Vacuum Metals, Inc., 70 Memorial Drive, Cambridge 42, Mass.
Wall Colmonoy Corp., 19345 John R. St., Detroit 3, Mich.
Westinghouse Electric Corp., P. O. Box 868, Pittsburgh 30, Pa.

Nickel Ribbon

Alloy Metal Wire Co., 13th & Pennsylvania Ave., Prospect Park, Pa.
American Silver Co., 36–07 Prince St., Flushing, N. Y.
Driver-Harris Co., Harrison, N. J.
Jelliff Mfg. Corp., C. O., 122 Pequot Ave., Southport, Conn.

Palladium

American Platinum Works, N. J. R. R. Ave. at Oliver St., Newark 5, N. J.
American Silver Co., 36–07 Prince St., Flushing, N. Y.
Baker & Co., Inc., 113 Astor St., Newark 5, N. J.
Bishop & Co., J., Malvern, Pa.
Handy & Harman, 82 Fulton St., New York 38, N. Y.
Jarrell-Ash Co., 165 Newberry St., Boston 16, Mass.
Unick Chemical Co., 59 E. Madison St., Chicago 3, Ill.
Makepeace Co., D. E., Attleboro Mass.
Western Gold & Platinum Works, 589 Bryant St., San Francisco, Calif.

Phosphor Bronze

American Brass Co., Waterbury 20, Conn.
American Oxygen Service Corp., 600 Essex St., Harrison, N. J.
American Silver Co., 36–07 Prince St., Flushing, N. Y.
Belmont Smelting & Refining Works, Inc., 322 Belmont Ave., Brooklyn, N. Y.
Bridgeport Brass Co., 30 Grand St., Bridgeport 2, Conn.
Revere Copper & Brass, Inc., 230 Park Ave., New York 17, N. Y.

Platinum

American Platinum Works, N. J. R. R. Ave. at Oliver St., Newark 5, N. J.
American Silver Co., 36–07 Prince St., Flushing, N. Y.
Baker & Co., Inc., 113 Astor St., Newark 5, N. J.
Bishop & Co., J., Malvern, Pa.
Handy & Harman, 82 Fulton St., New York 38, N. Y.
Hommel Co., O., 209–213 Fourth Ave., Pittsburgh, Pa.
Western Gold & Platinum Works, 589 Bryant St., San Francisco, Calif.
Yonkers Laboratory Supply Co., 70 Palisade Ave., Yonkers 2, N. Y.

Polonium

ATOMIC ENERGY OF CANADA, LTD., Commercial Products Div., P. O. Box 93, Ottawa, Ontario, Canada. ADV. PG. 18
CANADIAN RADIUM & URANIUM CORP., 630 Fifth Ave., New York 20, N. Y. ADV. PG. 116
U. S. Radium Corp., 535 Pearl St., New York 7, N. Y.

Powdered

Belmont Smelting & Refining Works, Inc., 322 Belmont Ave., Brooklyn, N. Y.
Division Lead Co., 836 W. Kinzie St., Chicago 22, Ill.
du Pont de Nemours & Co., Inc., E. I., Wilmington 98, Del.
General Dyestuff Corp., 435 Hudson St., New York 14, N. Y.
Mallory & Co., Inc., P. R., 3029 E. Washington St., Indianapolis 6, Ind.
National Lead Co., 111 Broadway, New York 6, N. Y.

Radium

ATOMIC ENERGY OF CANADA, LTD., Commercial Products Div., P. O. Box 93, Ottawa, Ontario, Canada. ADV. PG. 18
Atomlab, Inc., 489 Fifth Ave., New York 17, N. Y.
CANADIAN RADIUM & URANIUM CORP., 630 Fifth Ave., New York 20, N. Y. ADV. PG. 116
Radium Chemical Co., 161 E. 42nd St., New York 17, N. Y.
U. S. Radium Corp., 535 Pearl St., New York 7, N. Y.

Silicon

Belmont Smelting & Refining Works, Inc., 322 Belmont Ave., Brooklyn, N. Y.
Electro Metallurgical Co., Div. of Union Carbide & Carbon Corp., 30 E. 42nd St., New York 17, N. Y.
Sylvania Electric Products, Inc., 1740 Broadway, New York 19, N. Y.
U. S. Steel Co., 525 Wm. Penn Bldg., Pittsburgh 30, Pa.
Vacuum Metals, Inc., 70 Memorial Drive, Cambridge 42, Mass.

Silver

American Platinum Works, N. J. R. R. Ave. at Oliver St., Newark 5, N. J.
American Silver Co., 36–07 Prince St., Flushing, N. Y.
Baker & Co., Inc., 113 Astor St., Newark 5, N. J.
Belmont Smelting & Refining Works, Inc., 322 Belmont Ave., Brooklyn, N. Y.
Bishop & Co., J., Malvern, Pa.
General Biochemicals Inc., Laboratory Park, Chagrin Falls, Ohio
Handy & Harman, 82 Fulton St., New York 38, N. Y.
Hill Co., C. R., 35 W. Grand River, Detroit 26, Mich.
Hommel Co., O., 209–213 Fourth Ave., Pittsburgh, Pa.
Jarrell-Ash Co., 165 Newberry St., Boston 16, Mass.
Makepeace Co., D. E., Attleboro, Mass.
Mallinckrodt Chemical Works, Second & Mallinckrodt Sts., St. Louis 7, Mo.
Western Gold & Platinum Works, 589 Bryant St., San Francisco, Calif.

Silver Alloys and Compounds

American Oxygen Service Corp., 600 Essex St., Harrison, N. J.
American Platinum Works, N. J. R. R. Ave. at Oliver St., Newark 5, N. J.
American Silver Co., 36–07 Prince St., Flushing, N. Y.
Baker & Co., Inc., 113 Astor St., Newark 5, N. J.
Belmont Smelting & Refining Works, Inc., 322 Belmont Ave., Brooklyn, N. Y.
Handy & Harman, 82 Fulton St., New York 38, N. Y.
Hommel Co., O., 209–213 Fourth Ave., Pittsburgh, Pa.
Mallinckrodt Chemical Works, Second & Mallinckrodt Sts., St. Louis 7, Mo.
Mallory & Co., Inc., P. R., 3029 E. Washington St., Indianapolis 6, Ind.
Noy Co., J. M., 71 Elm St., Hartford 1, Conn.
Western Gold & Platinum Works, 589 Bryant St., San Francisco, Calif.

Steel

Allegheny Ludlum Steel Corp., 2020 Oliver Bldg., Pittsburgh 22, Pa.
American Oxygen Service Corp., 600 Essex St., Harrison, N. J.
American Silver Co., 36–07 Prince St., Flushing, N. Y.
Astell & Co., John B., 90 W. Broadway, New York 7, N. Y.
Bethlehem Steel Co., Bethlehem, Pa.
Carpenter Steel Co., The, Reading, Pa.
Crucible Steel Co. of America, 405 Lexington Ave., New York 17, N. Y.
Revere Copper & Brass, Inc., 230 Park Ave., New York 17, N. Y.

Steel, Stainless

Allegheny Ludlum Steel Corp., 2020 Oliver Bldg., Pittsburgh 22, Pa.
Alloy Metal Wire Co., 13th & Pennsylvania Ave., Prospect Park, Pa.
American Oxygen Service Corp., 600 Essex St., Harrison, N. J.
American Silver Co., 36–07 Prince St., Flushing, N. Y.
BAR-RAY PRODUCTS, INC., 209 25th St., Brooklyn 32, N. Y. ADV. PG. 112
Bishop & Co., J., Malvern, Pa.
Carpenter Steel Co., The, Reading, Pa.
Driver-Harris Co., Harrison, N. J.
U. S. Steel Co., 525 Wm. Penn Bldg., Pittsburgh 30, Pa.

Tantalum

American Silver Co., 36–07 Prince St., Flushing, N. Y.
Bishop & Co., J., Malvern, Pa.
Electro Metallurgical Co., Div. of Union Carbide & Carbon Corp., 30 E. 42nd St., New York 17, N. Y.
Jarrell-Ash Co., 165 Newberry St., Boston 16, Mass.

Thermostatic Bi-Metals

See BI-METALS—Thermostatic

Tin

Alpha Metals, Inc., P. O. Box 34, 56 Water St., Jersey City, N. J.
American Smelting & Refining Co., 120 Broadway, New York 5, N. Y.
Belmont Smelting & Refining Works, Inc., 322 Belmont Ave., Brooklyn, N. Y.
Division Lead Co., 836 W. Kinzie St., Chicago 22, Ill.
Federated Metals Div., American Smelting & Refining Co., 120 Broadway, New York 5, N. Y.
Hommel Co., O., 209–213 Fourth Ave., Pittsburgh, Pa.
Jarrell-Ash Co., 165 Newberry St., Boston 16, Mass.
Mallinckrodt Chemical Works, Second & Mallinckrodt Sts., St. Louis 7, Mo.
National Lead Co., 111 Broadway, New York 6, N. Y.

Titanium

American Silver Co., 36–07 Prince St., Flushing, N. Y.
Belmont Smelting & Refining Works, Inc., 322 Belmont Ave., Brooklyn, N. Y.
Bishop & Co., J., Malvern, Pa.
Crucible Steel Co. of America, 405 Lexington Ave., New York 17, N. Y.
du Pont de Nemours & Co., Inc., E. I., Wilmington 98, Del.
Electro Metallurgical Co., Div. of Union Carbide & Carbon Corp., 30 E. 42nd St., New York 17, N. Y.
Hommel Co., O., 209–213 Fourth Ave., Pittsburgh, Pa.
Jarrell-Ash Co., 165 Newberry St., Boston 16, Mass.
Mallory & Co., Inc., P. R., 3029 E. Washington St., Indianapolis 6, Ind.
Metal Hydrides, Inc., 12–24 Congress St., Beverly, Mass.

Tungsten

American Silver Co., 36–07 Prince St., Flushing, N. Y.
Belmont Smelting & Refining Works, Inc., 322 Belmont Ave., Brooklyn, N. Y.
Cross Co., H., 15 Beekman St., New York 7, N. Y.
Electro Metallurgical Co., Div. of Union Carbide & Carbon Corp., 30 E. 42nd St., New York 17, N. Y.
Sylvania Electric Products, Inc., 1740 Broadway, New York 19, N. Y.

Tungsten Ribbon

American Silver Co., 36–07 Prince St., Flushing, N. Y.
Cross Co., H., 15 Beekman St., New York 7, N. Y.
Sylvania Electric Products, Inc., 1740 Broadway, New York 19, N. Y.

Uranium

Mallinckrodt Chemical Works, Second & Mallinckrodt Sts., St. Louis 7, Mo.

Zinc

American Smelting & Refining Co., 120 Broadway, New York 5, N. Y.
Belmont Smelting & Refining Works, Inc., 322 Belmont Ave., Brooklyn, N. Y.
Division Lead Co., 836 W. Kinzie St., Chicago 22, Ill.
Eagle-Picher Co., Cincinnati, Ohio
Federated Metals Div., American Smelting & Refining Co., 120 Broadway, New York 5, N. Y.
Hommel Co., O., 209–213 Fourth Ave., Pittsburgh, Pa.
Jarrell-Ash Co., 165 Newberry St., Boston 16, Mass.
National Lead Co., 111 Broadway, New York 6, N. Y.

Zirconium

American Silver Co., 36–07 Prince St., Flushing, N. Y.
Belmont Smelting & Refining Works, Inc., 322 Belmont Ave., Brooklyn, N. Y.
Electro Metallurgical Co., Div. of Union Carbide & Carbon Corp., 30 E. 42nd St., New York 17, N. Y.
Foote Mineral Co., 18 W. Chelten Ave., Philadelphia 44, Pa.
Hommel Co., O., 209–213 Fourth Ave., Pittsburgh, Pa.
Metal Hydrides, Inc., 12–24 Congress St., Beverly, Mass.

METERS—Counting Rate

Air Associates, Inc., Teterboro, N. J.
American Instrument Co., Inc., 8030 Georgia Ave., Silver Spring, Md.
Atomlab, Inc., 489 Fifth Ave., New York 17, N. Y.
Automatic Temperature Control Co., Inc., 5206 Pulaski Ave., Philadelphia 44, Pa.
Berkeley Scientific Div. of Beckman Instruments, 2200 Wright Ave., Richmond, Calif.
Bristol Co., The, Waterbury 20, Conn.
Cinema-Television Ltd., Worsley Bridge Rd., London, S. E. 26, England
COLE, LTD., E. K., Electronics Div., Malmesbury, Wiltshire, England. ADV. PG. 28
Decade Instrument Co., P. O. Box 153, Caldwell, N. J.
Detectron Co., 5631 Cahuenga Blvd., North Hollywood, Calif.
Douglas Radio Labs., 176 Norfolk Ave., Boston 19, Mass.
El-Tronics, Inc., 2649 N. Howard St., Philadelphia 33, Pa.
GENERAL ELECTRIC CO., Apparatus Sales Div., Schenectady 5, N. Y. ADV. PGS. 2–3
General Radio Co., 275 Massachusetts Ave., Cambridge 30, Mass.
Leland Instruments Ltd., 22–23 Millbank, London, S. W. 1, England
Macdonald Co., Inc., W. S., 33 University Rd., Cambridge 38, Mass.
MEASUREMENTS CORP., Boonton, N. J. ADV. PG. 98
Measurement Engineering Ltd., Arnprior, Ontario, Canada
New London Instrument Co., P. O. Box 189, New London, Conn.
North American Philips Co., Inc., 100 E. 42nd St., New York 17, N. Y.
NUCLEAR INSTRUMENT & CHEMICAL CO., 223 W. Erie St., Chicago 10, Ill. ADV. PG. Back Cover
Nuclear Measurements Corp., 2460 N. Arlington Ave., Indianapolis 18, Ind.
NUCLEAR RESEARCH CORP., 2565 Grays Ferry Ave., Philadelphia 46, Pa. ADV. PG. 97
NUCLEAR RESEARCH & DEVELOPMENT INC., 1094 Sutter Ave., St. Louis, Mo. ADV. PG. 103
Nuclear Specialty Co., P. O. Box 455, Center Moriches, N. Y.
NUCLEONIC CO. OF AMERICA, 497 Union St., Brooklyn 31, N. Y. ADV. PG. 112
Patterson, Moos & Co., Inc., 32–36 47th Ave., Long Island City 1, N. Y.
Phoenix Precision Instrument Co., 3803–05 N. 5th St., Philadelphia, Pa.
Photocon Research Products, 421 N. Foothill Blvd., Pasadena 7, Calif.
R-C SCIENTIFIC INSTRUMENT CO., 335 Culver Blvd., Playa Del Rey, Calif. ADV. PG. 129
Radiation Counter Labs., Inc., 1844 W. 21st St., Chicago 8, Ill.
RADIATION INSTRUMENT DEVELOPMENT LAB., 2337 W. 67th St., Chicago 36, Ill. ADV. PG. Inside Back Cover
RADIO CORP. OF AMERICA, RCA VICTOR DIV., ENGINEERING PRODUCTS DEPT., Front & Cooper Sts., Camden, N. J. ADV. PG. 13
RADIOACTIVE PRODUCTS, INC., 443 Congress St., Detroit 26, Mich. ADV. PG. 8
Square Root Mfg. Corp., 391 Saw Mill River Rd., Yonkers, N. Y.
Standard Electronics Research Corp., 2 East End Ave., New York 21, N. Y.
TECHNICAL ASSOCIATES, INC., 140 W. Providencia Ave., Burbank, Calif. ADV. PG. 130
TECHNICAL OPERATIONS, INC., 6 Schuster Court, Arlington 74, Mass. ADV. PG. 128
TRACERLAB, INC., 130 High St., Boston 10, Mass. ADV. PG. 24
VICTOREEN INSTRUMENT CO., 3800 Perkins Ave., Cleveland 14, Ohio. ADV. PG. Inside Front Cover
Walkirt Co., 145 W. Hazel, Inglewood, Calif.
Wang Laboratories, 296 Columbus Ave., Boston 16, Mass.
WATERS, INC., ROBERT A., 4 Gordon St., Waltham 54, Mass. ADV. PG. 115
Western Radiation Lab., 1107 W. 24th St., Los Angeles 27, Calif.
WESTON ELECTRICAL INSTRUMENT CORP., 614 Frelinghuysen Ave., Newark 5, N. J. ADV. PG. 102

METERS—Electric

Allied Radio Corp., 833 W. Jackson Blvd., Chicago 7, Ill.
Automatic Temperature Control Co., Inc., 5206 Pulaski Ave., Philadelphia 44, Pa.
Beede Electrical Instrument Co., Penacook, N. H.
Bristol Co., The, Waterbury 20, Conn.
C. G. S. Laboratories, Inc., 391 Ludlow St., Stamford, Conn.
CAMBRIDGE INSTRUMENT CO., INC., 3786 Grand Central Terminal, New York 17, N. Y. ADV. PG. 123
Cole Instrument Co., 1320 S. Grand Ave., Los Angeles 15, Calif.
DeJur-Amsco Corp., 45–01 Northern Blvd., Long Island City 1, N. Y.
Electric Design & Mfg. Corp., Burlington, Iowa
Electronic Measurements Co., Inc., Lewis St. & Maple Ave., Eatontown, N. J.
Esterline-Angus Co., Inc., P. O. Box 596, Indianapolis 6, Ind.
GENERAL ELECTRIC CO., Apparatus Sales Div., Schenectady 5, N. Y. ADV. PGS. 2–3
Hays Corp., Michigan City, Ind.
Hickok Electrical Instrument Co., The, 10514 Dupont Ave., Cleveland 8, Ohio
Industrial Controls, Inc., 525 N. Noble St., Chicago 22, Ill.
Instrument Laboratories, 315 W. Walton Place, Chicago 10, Ill.
International Instruments, Inc., P. O. Box 2954, New Haven 15, Conn.
Leeds & Northrup Co., 4970 Stenton Ave., Philadelphia 44, Pa.
Manning, Maxwell & Moore, Inc., Stratford, Conn.
Martindale Electric Co., 1375 Hird Ave., Cleveland 7, Ohio
Measurement Engineering Ltd., Arnprior, Ontario, Canada
Millivac Instruments, 444 Second St., Box 997, Schenectady, N. Y.
Phaostron Co., 151 Pasadena Ave., South Pasadena, Calif.
Precision Apparatus Co., Inc., 92–27 Horace Harding Blvd., Elmhurst, N. Y.
Rawson Electrical Instrument Co., 114 Potter St., Cambridge 42, Mass.
Sangamo Electric Co., Springfield, Ill.
Simpson Electric Co., Div. of American Gage & Machine Co., 5208 W. Kinzie St., Chicago 44, Ill.
Square Root Mfg. Corp., 391 Saw Mill River Rd., Yonkers, N. Y.
Sticht, Inc., Herman H., 27 Park Place, New York 7, N. Y.
Sun Electric Corp., 6323 Avondale Ave., Chicago 31, Ill.
Western Sound & Electric Labs., Inc., 805 S. Fifth St., Milwaukee 4, Wis.
Welch Scientific Co., W. M., 1515 Sedgwick St., Chicago 10, Ill.
Westinghouse Electric Corp., P. O. Box 868, Pittsburgh 30, Pa.

METERS—Flow

American Oxygen Service Corp., 600 Essex St., Harrison, N. J.
Automatic Temperature Control Co., Inc., 5206 Pulaski Ave., Philadelphia 44, Pa.
Berkeley Scientific Div. of Beckman Instruments, 2200 Wright Ave., Richmond, Calif.
Bristol Co., The, Waterbury 20, Conn.
Brooks Rotameter Co., Box A-1347, Lansdale, Pa.
Builders-Providence, Inc., P. O. Box 1342, Providence 1, R. I.
Daylight Vacuum Products Co., 5207 N. Milwaukee Ave., Chicago 30, Ill.
Fischer & Porter Co., 50 County Line Rd., Hatboro, Pa.
Fisher Scientific Co., 709 Forbes St., Pittsburgh 19, Pa.
Foxboro Co., 38 Neponset Ave., Foxboro, Mass.
Hagen Corp., 323 Fourth Ave., Pittsburgh 30, Pa.
Hastings Instrument Co., Super Highway at Pine Ave., Hampton, Va.
Hays Corp., Michigan City, Ind.
Inflico, Inc., P. O. Box 5033, Tuscon, Ariz.
Kahl Scientific Instrument Corp., Box 1166, El Cajon, Calif.
Leeds & Northrup Co., 4970 Stenton Ave., Philadelphia 44, Pa.
Minneapolis-Honeywell Regulator Co., 2753 Fourth Ave. S., Minneapolis, Minn.
MINNEAPOLIS-HONEYWELL REGULATOR CO., Wayne & Roberts Aves., Philadelphia 44, Pa. ADV. PG. 29
Phoenix Precision Instrument Co., 3803–05 North 5th St., Philadelphia, Pa.
Republic Flow Meters Co., 2240 Diversey Pkwy., Chicago 47, Ill.
Roller-Smith Corp., 1000 Eighth Ave., Bethlehem, Pa.
Scientific Glass Apparatus Co., Inc., 100 Lakewood Terrace, Bloomfield, N. J.
Simplex Valve & Meter Co., 68th & Upland Sts., Philadelphia 42, Pa.
Taylor Instrument Companies, 95 Ames St., Rochester, N. Y.
TECHNITROL ENGINEERING CORP., 2751 N. 4th St., Philadelphia 33, Pa. ADV. PG. 132
U. S. Gauge Div., American Machine & Metals, Inc., Sellersville, Pa.
Vitro Corp. of America, 233 Broadway, New York 7, N. Y.
Worthington Corp., 426 Worthington Ave., Harrison, N. J.

METERS—Gas, Precision Metering

American Oxygen Service Corp., 600 Essex St., Harrison, N. J.
Automatic Temperature Control Co., Inc., 5206 Pulaski Ave., Philadelphia 44, Pa.
Bristol Co., The, Waterbury 20, Conn.
Fischer & Porter Co., 50 County Line Rd., Hatboro, Pa.
Hays Corp., Michigan City, Ind.
Lapp Insulator Co., Inc., 31 Gilbert St., LeRoy, N. Y.
Leeds & Northrup Co., 4970 Stenton Ave., Philadelphia 44, Pa.
Phoenix Precision Instrument Co., 3803–05 N. 5th St., Philadelphia, Pa.
Precision Scientific Co., 3737 W. Cortland St., Chicago 47, Ill.

METERS—Gauss

CAMBRIDGE INSTRUMENT CO., INC., 3786 Grand Central Terminal, New York 17, N. Y. ADV. PG. 123
DYNA LABS., INC., 1075 Stewart Ave., Garden City, N. Y. ADV. PG. 133
GENERAL ELECTRIC CO., Apparatus Sales Div., Schenectady 5, N. Y. ADV. PGS. 2–3
Leeds & Northrup Co., 4970 Stenton Ave., Philadelphia 44, Pa.
Magnaflux Corp., 5900 Northwest Highway, Chicago 31, Ill.
Marion Electrical Instrument Co., 402 Canal St., Manchester, N. H.
Phoenix Precision Instrument Co., 3803–05 N. 5th St., Philadelphia, Pa.
Rawson Electrical Instrument Co., 114 Potter St., Cambridge 42, Mass.
Varian Associates, 990 Varian St., San Carlos, Calif.

METERS—pH

American Instrument Co., Inc., 8030 Georgia Ave., Silver Spring, Md.
Beckman Instruments, Inc., 820 Mission St., South Pasadena 183, Calif.
Bristol Co., The, Waterbury 20, Conn.
CAMBRIDGE INSTRUMENT CO., INC., 3786 Grand Central Terminal, New York 17, N. Y. ADV. PG. 123
Central Scientific Co., 1700 Irving Park Rd., Chicago 13, Ill.
Coleman Instruments, Inc., Maywood, Ill.
Electrodyne Co., 32 Oliver St., Boston, Mass.
Foxboro Co., 38 Neponset Ave., Foxboro, Mass.
Interelectronics Corp., 2432 Grand Concourse, New York 58, N. Y.
Leeds & Northrup Co., 4970 Stenton Ave., Philadelphia 44, Pa.
Macbeth Corp., Cochetan Turnpike, P. O. Box 950, Newburgh, N. Y.
Marconi Instruments, Ltd., 23–25 Beaver St., New York 4, N. Y.
Minneapolis-Honeywell Regulator Co., 2753 Fourth Ave. S., Minneapolis, Minn.
MINNEAPOLIS-HONEYWELL REGULATOR CO., Wayne & Roberts Aves., Philadelphia 44, Pa. ADV. PG. 29
Photovolt Corp., 95 Madison Ave., New York 16, N. Y.
Precision Scientific Co., 3737 W. Cortland St., Chicago 47, Ill.
Process & Instruments, 60 Greenpoint Ave., Brooklyn 22, N. Y.
Welch Scientific Co., W. M., 1515 Sedgwick St., Chicago 10, Ill.
Yonkers Laboratory Supply Co., 70 Palisade Ave., Yonkers 2, N. Y.

METERS—Recording

Automatic Temperature Control Co., Inc., 5206 Pulaski Ave., Philadelphia 44, Pa.
Bristol Co., The, Waterbury 20, Conn.
Builders-Providence, Inc., P. O. Box 1342, Providence 1, R. I.
CAMBRIDGE INSTRUMENT CO., INC., 3786 Grand Central Terminal, New York 17, N. Y. ADV. PG. 123
Cinema Television Ltd., Worsley Bridge Rd., London, S. E. 26, England
Cutler-Hammer Inc., 412 N. 12th St., Milwaukee 1, Wis.
Esterline-Angus Co., Inc., P. O. Box 596, Indianapolis 6, Ind.
Fielden Instrument Division, Robertshaw-Fulton Controls Co., 2920 N. 4th St., Philadelphia 33, Pa.
Foxboro Co., 38 Neponset Ave., Foxboro, Mass.
Hays Corp., Michigan City, Ind.
Inflico, Inc., P. O. Box 5033, Tuscon, Ariz.
Leeds & Northrup Co., 4970 Stenton Ave., Philadelphia 44, Pa.
Manning, Maxwell & Moore, Inc., Stratford, Conn.
Minneapolis-Honeywell Regulator Co., 2753 Fourth Ave. S., Minneapolis, Minn.
MINNEAPOLIS-HONEYWELL REGULATOR CO., Wayne & Roberts Aves., Philadelphia 44, Pa. ADV. PG. 29
Phoenix Precision Instrument Co., 3803–05 N. 5th St., Philadelphia, Pa.
Roller-Smith Corp., 1000 Eighth Ave., Bethlehem, Pa.
Sangamo Electric Co., Springfield, Ill.
Simplex Valve & Meter Co., 68th & Upland Sts., Philadelphia 42, Pa.
Streeter-Amet Co., 4101 Ravenswood Ave., Chicago 13, Ill.
Taylor Instrument Companies, 95 Ames St., Rochester, N. Y.
Weksler Thermometer Corp., Martinique Bldg., 49 W. 32nd St., New York 1, N. Y.
Westinghouse Electric Corp., P. O. Box 868, Pittsburgh 30, Pa.
Worthington Corp., 426 Worthington Ave., Harrison, N. J.

METERS—Roughness

Beede Electrical Instrument Co., Inc., Penacook, N. H.
Brush Development Co., 3405 Perkins Ave., Cleveland 14, Ohio
GENERAL ELECTRIC CO., Apparatus Sales Div., Schenectady 5, N. Y. ADV. PGS. 2–5
Phoenix Precision Instrument Co., 3803–05 N. 5th St., Philadelphia, Pa.
Precision Scientific Co., 3737 W. Cortland St., Chicago 47, Ill.
VICTOREEN INSTRUMENT CO., 3800 Perkins Ave., Cleveland 14, Ohio. ADV. PG. Inside Front Cover

METERS—Survey, Radiation

Alco Mfg. Co., 4011 Cuming St., Omaha 3, Neb.
ATOMIC INSTRUMENT CO., 84 Massachusetts Ave., Cambridge 39, Mass. ADV. PG. 23
Atomlab, Inc., 489 Fifth Ave., New York 17, N. Y.
Baldwin Instrument Co., Ltd., Brooklands Works, Dartford, Kent, England
COLE, LTD., E. K., Electronics Div., Malmesbury, Wiltshire, England. ADV. PG. 28
Detectron Co., 3631 Cahuenga Blvd., North Hollywood, Calif.
Douglas Radio Labs., 176 Norfolk Ave., Boston 19, Mass.
El-Tronics, Inc., 2649 N. Howard St., Philadelphia 33, Pa.
Falk & Co., Ltd., M., 5 Victoria St., London, S. W. 1, England
GENERAL ELECTRIC CO., Apparatus Sales Div., Schenectady 5, N. Y. ADV. PGS. 2–5
Landsverk Electrometer Co., 550–552 W. Garfield Ave., Glendale 4, Calif.
Measurement Engineering Ltd., Arnprior, Ontario, Canada
MINE SAFETY APPLIANCES CO., 201 N. Braddock Ave., Pittsburgh 21, Pa. ADV. PG. 130
Nuclear Development Laboratory, P. O. Box 7034, Kansas City, Mo.
NUCLEAR INSTRUMENT & CHEMICAL CORP., 223 W. Erie St., Chicago 10, Ill. ADV. PG. Back Cover
NUCLEAR RESEARCH CORP., 2563 Grays Ferry Ave., Philadelphia 46, Pa. ADV. PG. 97
NUCLEAR RESEARCH & DEVELOPMENT INC., 1094 Sutter Ave., St. Louis, Mo. ADV. PG. 103
NUCLEONIC CO. OF AMERICA, 497 Union St., Brooklyn 31, N. Y. ADV. PG. 112
Ohmart Corp., The, 2347 Ferguson Ave., Cincinnati 38, Ohio
Patterson, Maos & Co., Inc., 32–36 47th Ave., Long Island City 1, N. Y.
R-C SCIENTIFIC INSTRUMENT CO., 335 Culver Blvd., Playa Del Rey, Calif. ADV. PG. 129
Radiation Counter Labs., Inc., 1844 W. 21st St., Chicago 8, Ill.
RADIOACTIVE PRODUCTS, INC., 443 W. Congress St., Detroit 26, Mich. ADV. PG. 8
TECHNICAL ASSOCIATES, INC., 140 W. Providencia Ave., Burbank, Calif. ADV. PG. 130
TECHNICAL OPERATIONS, INC., 6 Schouler Court, Arlington 74, Mass. ADV. PG. 128
TRACERLAB, INC., 130 High St., Boston 10, Mass. ADV. PG. 24
VICTOREEN INSTRUMENT CO., 3800 Perkins Ave., Cleveland 14, Ohio. ADV. PG. Inside Front Cover
Western Radiation Lab., 1107 W. 24th St., Los Angeles 27, Calif.

METERS—Thermocouple

Allied Radio Corp., 833 W. Jackson Blvd., Chicago 7, Ill.
Bristol Co., The, Waterbury 20, Conn.
Cole Instrument Co., 1320 S. Grand Ave., Los Angeles 15, Calif.
Electric Design & Mfg. Corp., Burlington, Iowa
Farrand Optical Co., Inc., Bronx Blvd. at 238th St., New York 70, N. Y.
Foxboro Co., 38 Neponset Ave., Foxboro, Mass.
Fredericks Co., George E., Bethayres, Pa.
General Controls Co., Glendale 1, Calif.
Hastings Instrument Co., Super Highway at Pine Ave., Hampton, Va.
Hickok Electrical Instrument Co., The, 10514 Dupont Ave., Cleveland 8, Ohio
Industrial Controls, Inc., 525 N. Noble St., Chicago 22, Ill.
Leeds & Northrup Co., 4970 Stenton Ave., Philadelphia 44, Pa.
Marion Electrical Instrument Co., 402 Canal St., Manchester, N. H.
Measurement Engineering Ltd., Arnprior, Ontario, Canada
Meters, Inc., 5353 N. Keystone Ave., Indianapolis 20, Ind.
MINNEAPOLIS-HONEYWELL REGULATOR CO., Wayne & Roberts Aves., Philadelphia 44, Pa. ADV. PG. 29
Pyrometer Instrument Co., Inc., Bergenfield, N. J.
Rawson Electrical Instrument Co., 114 Potter St., Cambridge 42, Mass.
Sensitive Research Instrument Corp., 9 Elm Ave., Mt. Vernon, N. Y.
Simpson Electric Co., Div. of American Gage & Machine Co., 5208 W. Kinzie St., Chicago 44, Ill.
Sun Electric Corp., 6323 Avondale Ave., Chicago 31, Ill.
Taco West Corp., 525 N. Noble St., Chicago 22, Ill.
Thwing-Albert Instrument Co., Penn St. & Pulaski Ave., Philadelphia 44, Pa.
Triplett Electrical Instrument Co., 286 Harmon Rd., Bluffton, Ohio
Westinghouse Electric Corp., P. O. Box 868, Pittsburgh 30, Pa.
Winslow Co., Inc., 9 Liberty St., Newark, N. J.

METERS—Water Turbidity

American Instrument Co. Inc., 8030 Georgia Ave., Silver Spring, Md.
Permutit Co., 330 W. 42nd St., New York 36, N. Y.
Phipps & Bird, Inc., 303 S. 6th St., Richmond 5, Va.
Phoenix Precision Instrument Co., 3803–05 North 5th St., Philadelphia, Pa.

METERS—X-Ray Intensity

ANTON ELECTRONIC LABS., INC., 1226–38 Flushing Ave., Brooklyn 37, N. Y. ADV. PG. 136
Baldwin Instrument Co., Ltd., Brooklands Works, Dartford, Kent, England
CAMBRIDGE INSTRUMENT CO., INC., 3786 Grand Central Terminal, New York 17, N. Y. ADV. PG. 123
COLE, LTD., E. K., Electronics Div., Malmesbury, Wiltshire, England. ADV. PG. 28
Douglas Radio Labs., 176 Norfolk Ave., Boston 19, Mass.
El-Tronics, Inc., 2649 N. Howard St., Philadelphia 33, Pa.
Falk & Co., Ltd., M., 5 Victoria St., London, S. W. 1, England
Fleming Radio Ltd., 18–20 Laystall St., London, E. C. 1, England
Landsverk Electrometer Co., 550–552 W. Garfield Ave., Glendale 4, Calif.
Leeds & Northrup Co., 4970 Stenton Ave., Philadelphia 44, Pa.
NUCLEAR INSTRUMENT & CHEMICAL CORP., 223 W. Erie St., Chicago 10, Ill. ADV. PG. Back Cover
NUCLEAR RESEARCH & DEVELOPMENT INC., 1094 Sutter Ave., St. Louis, Mo. ADV. PG. 103
NUCLEONIC CO. OF AMERICA, 497 Union St., Brooklyn 31, N. Y. ADV. PG. 112
Ohmart Corp., The, 2347 Ferguson Ave., Cincinnati 38, Ohio
Patterson, Maos & Co., Inc., 32–36 47th Ave., Long Island City 1, N. Y.
Picker X-Ray Corp., 25 S. Broadway, White Plains, N. Y.
R-C SCIENTIFIC INSTRUMENT CO., 335 Culver Blvd., Playa Del Rey, Calif. ADV. PG. 129
TRACERLAB, INC., 130 High St., Boston 10, Mass. ADV. PG. 24
VICTOREEN INSTRUMENT CO., 3800 Perkins Ave., Cleveland 14, Ohio. ADV. PG. Inside Front Cover

MICA

Asheville-Schoonmaker Mica Co., Inc., 82 Worth St., New York 13, N. Y.
Continental-Diamond Fibre Co., Newark, Delaware
Doalcam Corp., 56 Elmwood St., Newton, Mass.
General Electric Co., Chemical Div., 1 Plastics Ave., Pittsfield, Mass.
Gulton Mfg. Corp., 212 Durham Ave., Metuchen, N. J.
Hommel Co., O., 209–213 Fourth Ave., Pittsburgh, Pa.
Mycalex Corp. of America, Clifton Blvd., Clifton, N. J.
NUCLEONIC CO. OF AMERICA, 497 Union St., Brooklyn 31, N. Y. ADV. PG. 112
Radiation Counter Labs., Inc., 1844 W. 21st St., Chicago 8, Ill.
Sylvania Electric Products, Inc., 1740 Broadway, New York 19, N. Y.

MICROAMMETERS

Allied Radio Corp., 833 W. Jackson Blvd., Chicago 7, Ill.
Assembly Products, Inc., Chagrin Falls 6, Ohio
Baldwin Instrument Co., Ltd., Brooklands Works, Dartford, Kent, England
Ballantine Laboratories, Inc., Boonton, N. J.
Beckman Instruments, Inc., 820 Mission St., South Pasadena 183, Calif.
Beede Electrical Instrument Co., Inc., Penacook, N. H.
Bristol Co., The, Waterbury 20, Conn.
Burlington Instrument Co., Burlington, Iowa
CAMBRIDGE INSTRUMENT CO., INC., 3786 Grand Central Terminal, New York 17, N. Y. ADV. PG. 123
Cole Instrument Co., 1320 S. Grand Ave., Los Angeles 15, Calif.
Dejur-Amsco Corp., 45–01 Northern Blvd., Long Island City 1, N. Y.
Electric Design & Mfg. Corp., Burlington, Iowa
Hickok Electrical Instrument Co., 10514 Dupont Ave., Cleveland 8, Ohio
Instrument Laboratories, 315 W. Walton Place, Chicago 10, Ill.
International Instruments, Inc., P. O. Box 2954, New Haven 15, Conn.
Keithley Instruments, 3868 Carnegie Ave., Cleveland, Ohio
Manning, Maxwell & Moore, Inc., Stratford, Conn.
Marion Electrical Instrument Co., 402 Canal St., Manchester, N. H.
Measurement Engineering Ltd., Arnprior, Ontario, Canada
Meters, Inc., 5353 N. Keystone Ave., Indianapolis 20, Ind.
Metropolitan Electronics & Instruments Co., 106 Fifth Ave., New York 11, N. Y.
Millivac Instruments, 444 Second St., Box 997, Schenectady, N. Y.
Oak Ridge Products Mfg. Div., Video Television, Inc., 37–01 Vernon Blvd., Long Island 1, N. Y.
Pheostron Co., 151 Pasadena Ave., South Pasadena, Calif.
Phoenix Precision Instrument Co., 3803–05 N. 5th St., Philadelphia, Pa.
Precision Apparatus Co., Inc., 92–27 Horace Harding Blvd., Elmhurst, N. Y.
Q. V. S. Inc., 20 N. 15th St., East Orange, N. J.
Radio City Products Co., Inc., 152 W. 25th St., New York 1, N. Y.
RADIO CORP. OF AMERICA, TUBE DEPT., Harrison, N. J. ADV. PG. 93
Rawson Electrical Instrument Co., 114 Potter St., Cambridge 42, Mass.
Sensitive Research Instrument Corp., 9 Elm Ave., Mt. Vernon, N. Y.
Simpson Electric Co. Div., American Gage & Machine Co., 5208 W. Kinzie St., Chicago 44, Ill.
Sun Electric Corp., 6323 Avondale Ave., Chicago 31, Ill.
Supreme, Inc., Greenwood, Miss.
Triplett Electrical Instrument Co., 286 Harmon Rd., Bluffton, Ohio
Welch Scientific Co., W. M., 1515 Sedgwick St., Chicago 10, Ill.
Westinghouse Electric Corp., P. O. Box 868, Pittsburgh 30, Pa.
WESTON ELECTRICAL INSTRUMENT CORP., 614 Frelinghuysen Ave., Newark 5, N. J. ADV. PG. 102
Winslow Co., Inc., 9 Liberty St., Newark, N. J.

MICROCHEMICAL EQUIPMENT

Alco Scientific Div. of A. S. Alco Co., 5655 Kingsbury Blvd., St. Louis 12, Mo.
CAMBRIDGE INSTRUMENT CO., INC., 3786 Grand Central Terminal, New York 17, N. Y. ADV. PG. 123

Chandler & Stedman, 398 Newton St., Waltham 54, Mass.
Fisher Scientific Co., 709 Forbes St., Pittsburgh 19, Pa.
Industrial Science Associates, 542 Fifth Ave., New York 19, N. Y.
Jarrell-Ash Co., 165 Newberry St., Boston 16, Mass.
Jasonols Chemical Corp., 1085 Myrtle Ave., Brooklyn 6, N. Y.
Precision Scientific Co., 3737 W. Cortland St., Chicago 47, Ill.
Radiation Counter Labs., Inc., 1844 W. 21st St., Chicago 8, Ill.
Radioisotope Application Co., 1843 University Ave., Berkeley 3, Calif.
Sargent & Co., E. H., 4647 W. Foster Ave., Chicago 30, Ill.
Scientific Service, Inc., 1417 Solano Ave., Albany, Calif.
Thomas Co., Arthur H., W. Washington Square, Philadelphia 5, Pa.
Yonkers Laboratory Supply Co., 70 Palisade Ave., Yonkers 2, N. Y.

MICRO-MICROAMMETERS—Electronic

Assembly Products, Inc., Chagrin Falls 6, Ohio
Atomlab, Inc., 489 Fifth Ave., New York 17, N. Y.
Baldwin Instrument Co., Ltd., Brooklands Works, Dartford, Kent, England
Beckman Instruments, Inc., 820 Mission St., South Pasadena 183, Calif.
BETA ELECTRIC CORP., 333 E. 103rd St., New York 29, N. Y. ADV. PG. 120
Dosicam Corp., 56 Elmwood St., Newton, Mass.
GENERAL ELECTRIC CO., Apparatus Sales Div., Schenectady 5, N. Y. ADV. POS. 2–5
Industrial Control Co., Straight Path & Arlington Ave., Wyandanch, N. Y.
Keithley Instruments, 3868 Carnegie Ave., Cleveland, Ohio
Leeds & Northrup Co., 4970 Stenton Ave., Philadelphia 44, Pa.
Metropolitan Electronics & Instruments Co., 106 Fifth Ave., New York 11, N. Y.
Millivac Instruments, 444 Second St., Box 997, Schenectady, N. Y.
Process & Instruments, 60 Greenpoint Ave., Brooklyn 22, N. Y.
Radiation Counter Labs., Inc., 1844 W. 21st St., Chicago 8, Ill.
Roller-Smith Corp., 1000 Eighth Ave., Bethlehem, Pa.
VICTOREEN INSTRUMENT CO., 3800 Perkins Ave., Cleveland 14, Ohio. ADV. PG. Inside Front Cover
Western Radiation Lab., 1107 W. 24th St., Los Angeles 27, Calif.
WESTON ELECTRICAL INSTRUMENT CORP., 614 Frelinghuysen Ave., Newark 5, N. J. ADV. PG. 102
Weston Laboratories, Weston 93, Mass.

MICROSCOPES—Binocular

American Optical Co., Instrument Div., Buffalo 15, N. Y.
Bausch & Lomb Optical Co., 630 St. Paul St., Rochester 2, N. Y.
Ferner Co., E. Y., 110 Pleasant St., Malden, Mass.
Jarrell-Ash Co., 165 Newberry St., Boston 16, Mass.
LEITZ, INC., E., 304 Hudson St. at Spring St., New York 13, N. Y. ADV. PG. 121
Yonkers Laboratory Supply Co., 70 Palisade Ave., Yonkers 2, N. Y.

MICROSCOPES—Electron

Farrand Optical Co., Inc., Bronx Blvd. & E. 238th St., New York 70, N. Y.
GENERAL ELECTRIC CO., Apparatus Sales Div., Schenectady 5, N. Y. ADV. POS. 2–5
LEITZ, INC., E., 304 Hudson St. at Spring St., New York 13, N. Y. ADV. PG. 121
North American Philips Co., Inc., 100 E. 42nd St., New York 17, N. Y.
RADIO CORP. OF AMERICA, RCA VICTOR DIV., ENGINEERING PRODUCTS DEPT., Front & Cooper Sts., Camden, N. J. ADV. PG. 13

MICROSCOPES—Laboratory

American Instrument Co., Inc., 8030 Georgia Ave., Silver Spring, Md.
American Optical Co., Instrument Div., Buffalo 15, N. Y.
Bausch & Lomb Optical Co., 630 St. Paul St., Rochester 2, N. Y.
Buhl Optical Co., 1009 Beech Ave., Pittsburgh 12, Pa.
Clarkstan Corp., 11921 SW Pico Blvd., Los Angeles 64, Calif.
Ferner Co., E. Y., 110 Pleasant St., Malden, Mass.
Gaertner Scientific Corp., 1237 Wrightwood Ave., Chicago, Ill.
Jarrell-Ash Co., 165 Newberry St., Boston 16, Mass.
LEITZ, INC., E., 304 Hudson St. at Spring St., New York 13, N. Y. ADV. PG. 121
MINE SAFETY APPLIANCES CO., 201 N. Braddock Ave., Pittsburgh 21, Pa. ADV. PG. 130
Yonkers Laboratory Supply Co., 70 Palisade Ave., Yonkers 2, N. Y.

MICROSCOPES—Petrographic

American Optical Co., Instrument Div., Buffalo 15, N. Y.
Bausch & Lomb Optical Co., 630 St. Paul St., Rochester 2, N. Y.
Ferner Co., E. Y., 110 Pleasant St., Malden, Mass.
Jarrell-Ash Co., 165 Newberry St., Boston 16, Mass.
LEITZ, INC., E., 304 Hudson St. at Spring St., New York 13, N. Y. ADV. PG. 121

MICROSCOPES—Stereoscopic

American Optical Co., Instrument Div., Buffalo 15, N. Y.
Bausch & Lomb Optical Co., 630 St. Paul St., Rochester 2, N. Y.
Ferner Co., E. Y., 110 Pleasant St., Malden, Mass.
Jarrell-Ash Co., 165 Newberry St., Boston 16, Mass.
LEITZ, INC., E., 304 Hudson St. at Spring St., New York 13, N. Y. ADV. PG. 121
Yonkers Laboratory Supply Co., 70 Palisade Ave., Ave., Yonkers 2, N. Y.

MICROSPECTROSCOPES

Farrand Optical Co., Inc., Bronx Blvd., at E. 238th St., New York 70, N. Y.
Jarrell-Ash Co., 165 Newberry St., Boston 16, Mass.

MICROTOMES

American Optical Co., Instrument Div., Buffalo 15, N. Y.
Bausch & Lomb Optical Co., 630 St. Paul St., Rochester 2, N. Y.
CAMBRIDGE INSTRUMENT CO., INC., 3786 Grand Central Terminal, New York 17, N. Y. ADV. PG. 123
Custom Scientific Instruments, Inc., P. O. Box 170, Arlington, N. J.
International Equipment Co., 1284 Soldiers Field Rd., Boston 35, Mass.
Jarrell-Ash Co., 165 Newberry St., Boston 16, Mass.
LEITZ, INC., E., 304 Hudson St. at Spring St., New York 13, N. Y. ADV. PG. 121
Mica Instrument Co., 80 Trowbridge St., Cambridge 38, Mass.
Thomas Co., Arthur H., W. Washington Square, Philadelphia 5, Pa.

MILLIAMMETERS

Allied Radio Corp., 833 W. Jackson Blvd., Chicago 7, Ill.
American Chronoscope Corp., 316 W. First St., Mt. Vernon, N. Y.
Assembly Products, Inc., Chagrin Falls 6, Ohio
Baldwin Instrument Co., Ltd., Brooklands Works, Dartford, Kent, England
Beede Electrical Instrument Co., Inc., Penacook, N. H.
Bristol Co., The, Waterbury 20, Conn.
Burlington Instrument Co., Burlington, Iowa
CAMBRIDGE INSTRUMENT CO., INC., 3786 Grand Central Terminal, New York 17, N. Y. ADV. PG. 123
Cole Instrument Co., 1320 S. Grand Ave., Los Angeles 15, Calif.
Dejur-Amsco Corp., 45-01 Northern Blvd., Long Island City 1, N. Y.
Electric Design & Mfg. Corp., Burlington, Iowa.
Electronic Instrument Co., Inc., 276 Newport St., Brooklyn 12, N. Y.
Esterline-Angus Co., Inc., P. O. Box 596, Indianapolis, Ind.
Feller Engineering & Mfg. Co., 8026 N. Monticello Ave., Skokie, Ill.
Hickok Electrical Instrument Co., 10514 Dupont Ave. Cleveland 8, Ohio
Instrument Laboratories, 315 W. Walton Place, Chicago 10, Ill.
International Instruments, Inc., P. O. Box 2054, New Haven 15, Conn.
Manning, Maxwell & Moore, Inc., Stratford, Conn.
Marion Electrical Instrument Co., 402 Canal St., Manchester, N. H.
Measurement Engineering Ltd., Arnprior, Ontario, Canada
Meters, Inc., 5353 N. Keystone Ave., Indianapolis 20, Ind.
Metropolitan Electronics & Instruments Co., 106 Fifth Ave., New York 11, N. Y.
Millivac Instruments, 444 Second St., Box 997, Schenectady, N. Y.
Oak Ridge Products Mfg. Div., Video Television, Inc., 37-01 Vernon Blvd., Long Island City 1, N. Y.
Phaostron Co., 151 Pasadena Ave., South Pasadena, Calif.
Phoenix Precision Instrument Co., 3803-05 N. 5th St., Philadelphia, Pa.
Precision Apparatus Co., Inc., 92-27 Horace Harding Blvd., Elmhurst, N. Y.
Radio City Products Co., Inc., 152 W. 25th St., New York 1, N. Y.
Rawson Electrical Instrument Co., 114 Potter St., Cambridge 42, Mass.
Roller-Smith Corp., 1000 Eighth Ave., Bethlehem, Pa.
Sensitive Research Instrument Corp., 9 Elm Ave., Mt. Vernon, N. Y.
Shurite Meters, 35 Hamilton St., New Haven 8, Conn.
Simpson Electric Co. Div., American Gage & Machine Co., 5208 W. Kinzie St., Chicago 44, Ill.
Sun Electric Corp., 6323 Avondale Ave., Chicago 31, Ill.
Supreme, Inc., Greenwood, Miss.
Triplett Electrical Instrument Co., 286 Harmon Rd., Bluffton, Ohio
Welch Scientific Co., W. M., 1515 Sedgwick St., Chicago 10, Ill.
Westinghouse Electric Corp., P. O. Box 868, Pittsburgh 30, Pa.
WESTON ELECTRICAL INSTRUMENT CORP., 614 Frelinghuysen Ave., Newark 5, N. J. ADV. PG. 102
Winslow Co., Inc., 9 Liberty St., Newark, N. J.

MILLS—Laboratory

Colloid Equipment Co., Inc., 50 Church St., New York 7, N. Y.
Coors Porcelain Co., Golden, Colo.
Fisher Scientific Co., 709 Forbes St., Pittsburgh 19, Pa.
Hammel Co., O., 209–213 Fourth Ave., Pittsburgh, Pa.
International Engineering, Inc., 1200 Bolander Ave., Dayton, Ohio
Phipps & Bird, Inc., 303 S. 6th St., Richmond 5, Va.
Pulverizing Machinery Co., 43 Chatham Rd., Summit, N. J.
Thomas Co., Arthur H., W. Washington Square, Philadelphia 5, Pa.
U. S. Stoneware Co., Akron 9, Ohio
Yonkers Laboratory Supply Co., 70 Palisade Ave., Yonkers 2, N. Y.

MIXERS—Laboratory

Aloe Scientific Div. of A. S. Aloe Co., 5655 Kingsbury Blvd., St. Louis 12, Mo.
American Instrument Co., Inc., 8030 Georgia Ave., Silver Spring, Md.
Brookfield Engineering Labs., Inc., Porter St., Stoughton, Mass.
Builders-Providence, Inc., P. O. Box 1342, Providence 1, R. I.
Daylight Vacuum Products Co., 5207 N. Milwaukee Ave., Chicago 30, Ill.
Central Scientific Co., 1700 Irving Park Rd., Chicago 13, Ill.
Colloid Equipment Co., Inc., 50 Church St., New York 7, N. Y.
Consolidated Siphon Supply Co., Inc., 24 Wooster St., New York, N. Y.
Fisher Scientific Co., 709 Forbes St., Pittsburgh 19, Pa.
General Mixing Equipment Co., 413 N. 3rd St., Philadelphia, Pa.
Hammel Co., O., 209–213 Fourth Ave., Pittsburgh, Pa.
International Engineering, Inc., 1200 Bolander Ave., Dayton, Ohio
Mixing Equipment Co., 192 Mt. Read Blvd., Rochester 11, N. Y.
Patterson-Kelley Co., Inc., East Stroudsburg, Pa.
Precision Scientific Co., 3737 W. Cortland St., Chicago 47, Ill.
U. S. Stoneware Co., Akron 9, Ohio
Welch Scientific Co., W. M., 1515 Sedgwick St., Chicago 10, Ill.
Yonkers Laboratory Supply Co., 70 Palisade Ave., Yonkers 2, N. Y.

MONITORS—Area

ANTON ELECTRONIC LABS., INC., 1226–38 Flushing Ave., Brooklyn 37, N. Y. ADV. PG. 136
Atomlab, Inc., 489 Fifth Ave., New York 17, N. Y.
Baldwin Instrument Co., Ltd., Brooklands Works, Dartford, Kent, England
COLE, LTD., E. K., Electronics Div., Malmesbury, Wiltshire, England. ADV. PG. 28
Douglas Radio Labs., 176 Norfolk Ave., Boston 19, Mass.
El-Tronics, Inc., 2649 N. Howard St., Philadelphia 33, Pa.
Falk & Co., Ltd., M., 5 Victoria St., London, S. W. 1, England
GENERAL ELECTRIC CO., Apparatus Sales Div., Schenectady 5, N. Y. ADV. POS. 2–5
NUCLEAR INSTRUMENT & CHEMICAL CORP., 223 W. Erie St., Chicago 10, Ill. ADV. PG. Back Cover
Nuclear Measurements Corp., 2460 N. Arlington Ave., Indianapolis 18, Ind.
NUCLEAR RESEARCH CORP., 2563 Grays Ferry Ave., Philadelphia 46, Pa. ADV. PG. 97
Ohmart Corp., The, 2347 Ferguson Ave., Cincinnati 38, Ohio

Patterson, Moos & Co., Inc., 32–36 47th Ave., Long Island City 1, N. Y.
R-C SCIENTIFIC INSTRUMENT CO., 335 Culver Blvd., Playa Del Rey, Calif. ADV. PG. 129
Radiation Counter Labs., Inc., 1844 W. 21st St., Chicago 8, Ill.
RADIATION INSTRUMENT DEVELOPMENT LAB., 2337 W. 67th St., Chicago 36, Ill. ADV. PG. Inside Back Cover
RADIOACTIVE PRODUCTS, INC., 443 W. Congress St., Detroit 26, Mich. ADV. PG. 8
TRACERLAB, INC., 130 High St., Boston 10, Mass. ADV. PG. 24
VICTOREEN INSTRUMENT CO., 3800 Perkins Ave., Cleveland 14, Ohio. ADV. PG. Inside Front Cover

MONITORS—Radioactivity

Airmec Laboratories, Ltd., High Wycombe, Buckinghamshire, England
Allied Radio Corp., 833 W. Jackson Blvd., Chicago 7, Ill.
ANTON ELECTRONIC LABS., INC., 1226–38 Flushing Ave., Brooklyn 37, N. Y. ADV. PG. 136
Atomlab, Inc., 489 Fifth Ave., New York 17, N. Y.
Baldwin Instrument Co., Ltd., Brooklands Works, Dartford, Kent, England
Berkeley Scientific Div. of Beckman Instruments, 2200 Wright Ave., Richmond, Calif.
CAMBRIDGE INSTRUMENT CO., INC., 3786 Grand Central Terminal, New York 17, N. Y. ADV. PG. 123
Canadian Marconi Co., P. O. Box 1690 (Place D'Armes), Montreal, Quebec, Canada
COLE, LTD., E. K., Electronics Div., Malmesbury, Wiltshire, England. ADV. PG. 28
Consolidated Engineering Corp., 300 N. Sierra Madre Villa, Pasadena 8, Calif.
Detectron Co., 5631 Cahuenga Blvd., North Hollywood, Calif.
Douglas Radio Labs., 176 Norfolk Ave., Boston 19, Mass.
El-Tronics, Inc., 2649 N. Howard St., Philadelphia 33, Pa.
Falk & Co., Ltd., M., 5 Victoria St., London, S. W. 1, England
Fleming Radio Ltd., 18–20 Laystall St., London, E. C. 1, England
GENERAL ELECTRIC CO., Apparatus Sales Div., Schenectady 5, N. Y. ADV. PGS. 2–5
Manufacturers Engineering & Equipment Corp., York & Mill Rds., Hatboro, Pa.
NUCLEAR INSTRUMENT & CHEMICAL CORP., 223 W. Erie St., Chicago 10, Ill. ADV. PG. Back Cover
Nuclear Measurements Corp., 2460 N. Arlington Ave., Indianapolis 18, Ind.
NUCLEAR RESEARCH CORP., 2563 Grays Ferry Ave., Philadelphia 46, Pa. ADV. PG. 97
NUCLEAR RESEARCH & DEVELOPMENT INC., 1094 Sutter Ave., St. Louis, Mo. ADV. PG. 103
NUCLEONIC CO. OF AMERICA, 497 Union St., Brooklyn 31, N. Y. ADV. PG. 112
Ohmart Corp., The, 2347 Ferguson Ave., Cincinnati 38, Ohio
R-C SCIENTIFIC INSTRUMENT CO., 335 Culver Blvd., Playa Del Rey, Calif. ADV. PG. 129
Radiation Counter Labs., Inc., 1844 W. 21st St., Chicago 8, Ill.
RADIATION INSTRUMENT DEVELOPMENT LAB., 2337 W. 67th St., Chicago 36, Ill. ADV. PG. Inside Back Cover
RADIOACTIVE PRODUCTS, INC., 443 W. Congress St., Detroit, Mich. ADV. PG. 8
St. John X-Ray Laboratory, Califon, N. J.
Special Instruments Laboratory, Inc., 1003 Highland Ave., Knoxville, Tenn.
TECHNICAL ASSOCIATES, INC., 140 W. Providencia Ave., Burbank, Calif. ADV. PG. 130
TECHNICAL OPERATIONS, INC., 6 Schouler Court, Arlington 74, Mass. ADV. PG. 128
TRACERLAB, INC., 130 High St., Boston 10, Mass. ADV. PG. 24
Twentieth Century Electronics, Ltd., Dunbar Works, Dunbar St., West Norwood, London S. E. 27, England
VICTOREEN INSTRUMENT CO., 3800 Perkins Ave., Cleveland 14, Ohio. ADV. PG. Inside Front Cover
Western Radiation Lab., 1107 W. 24th St., Los Angeles 27, Calif.

MONITORS—Sample

ANTON ELECTRONIC LABS., INC., 1226–38 Flushing Ave., Brooklyn 37, N. Y. ADV. PG. 136
Douglas Radio Labs., 176 Norfolk Ave., Boston 19, Mass.
El-Tronics, Inc., 2649 N. Howard St., Philadelphia 33, Pa.
GENERAL ELECTRIC CO., Apparatus Sales Div., Schenectady 5, N. Y. ADV. PGS. 2–5
NUCLEAR INSTRUMENT & CHEMICAL CORP., 223 W. Erie St., Chicago 10, Ill. ADV. PG. Back Cover
NUCLEAR RESEARCH CORP., 2563 Grays Ferry Ave., Philadelphia 46, Pa. ADV. PG. 97
Patterson, Moos & Co., Inc., 32–36 47th Ave., Long Island City 1, N. Y.
R-C SCIENTIFIC INSTRUMENT CO., 335 Culver Blvd., Playa Del Rey, Calif. ADV. PG. 129
Radiation Counter Labs., Inc., 1844 W. 21st St., Chicago 8, Ill.
TRACERLAB, INC., 130 High St., Boston 10, Mass. ADV. PG. 24
VICTOREEN INSTRUMENT CO., 3800 Perkins Ave., Cleveland 14, Ohio. ADV. PG. Inside Front Cover

MORTAR GRINDERS

Fisher Scientific Co., 709 Forbes St., Pittsburgh 19, Pa.

MORTARS—Mullite

Coors Porcelain Co., Golden, Colo.
Yonkers Laboratory Supply Co., 70 Palisade Ave., Yonkers 2, N. Y.

MORTARS & PESTLES

Armstrong Cork Co., 1010 Concord St., Lancaster, Pa.
Coors Porcelain Co., Golden, Colo.
Fisher Scientific Co., 709 Forbes St., Pittsburgh 19, Pa.
Humboldt Mfg. Co., 2814 N. Whipple St., Chicago 47, Ill.
Yonkers Laboratory Supply Co., 70 Palisade Ave., Yonkers 2, N. Y.

MOTOR—GENERATORS

Allied Radio Corp., 833 W. Jackson Blvd., Chicago 7, Ill.
Allis-Chalmers Mfg. Co., 935 S. 70th St., Milwaukee 1, Wis.
American Electric Motors, Inc., 4811–13 Telegraph Rd., Los Angeles, Calif.
Atlas Coil Winders, Inc., 392 State St., Stamford, Conn.
Bogue Electric Mfg. Co., 52 Iowa Ave., Paterson 3, N. J.
Bogue Railway Equipment Div. of Bogue Electric Mfg. Co., 52 Iowa Ave., Paterson 3, N. J.
Carter Motor Co., 2644 N. Maplewood Ave., Chicago 47, Ill.
Century Electric Co., 1806 Pine St., St. Louis 3, Mo.
Eastern Air Devices, Inc., 585 Dean St., Brooklyn 17, N. Y.
Electric Machinery Mfg. Co., 1331 N. E. Tyler St., Minneapolis 13, Minn.
Electric Products Co., 1725 Clarkstone Rd., Cleveland 12, Ohio
Electric Specialty Co., 211 South St., Stamford, Conn.
Generator Corp., 1820 N. Nash St., Arlington, Va.
Gothard Mfg. Co., 2110 Clear Lake Ave., Springfield, Ill.
Great Lakes Electric Mfg. Co., 17 S. Desplaines St., Chicago 6, Ill.
Holtzer-Cabot Div. of National Pneumatic Co., 130 Amory St., Boston 19, Mass.
Howard Industries, Inc., Divisions: Cyclohm Motor Corp., Electric Motor Corp., Racine, Wis.
Kahlenberg Bros. Co., 12th & Monroe Sts., Two Rivers, Wis.
Kato Engineering Co., 1415 First Ave., Mankato, Minn.
Leland Electric Co., The, Div. of American Machine & Foundry Co., 1501 Webster St., Dayton 1, Ohio
Mission Electric Mfg. Co., Inc., 132–134 W. Colorado, Pasadena 1, Calif.
Red Bank Division, Bendix Aviation Corp., Eatontown, N. J.
Redmond Co., Inc., Owosso, Mich.
Small Motors, Inc., 2076 Elston Ave., Chicago 14, Ill.
Vickers Electric Division, Vickers, Inc., 1815 Locust St., St. Louis, Mo.
Welch Scientific Co., W. M., 1515 Sedgwick St., Chicago 10, Ill.
Westinghouse Electric Corp., P. O. Box 868, Pittsburgh 30, Pa.
Wincharger Corp., E., 7th & Division Sts., Sioux City, Iowa

MOTORS—AC-FH

Alliance Mfg. Co., Lake Park Blvd., Alliance, Ohio
Allied Radio Corp., 833 W. Jackson Blvd., Chicago 7, Ill.
American Electric Motors, Inc., 4811–13 Telegraph Rd., Los Angeles, Calif.
Atlas Coil Winders, Inc., 392 State St., Stamford, Conn.
Bogue Electric Mfg. Co., 52 Iowa Ave., Paterson 3, N. J.
Century Electric Co., 1806 Pine St., St. Louis 3, Mo.
Dayton Electric Mfg. Co., 748 W. Adams, Chicago, Ill.
Electric Machinery Mfg. Co., 1331 N. E. Tyler St., Minneapolis 13, Minn.
Electric & Musical Industries, Ltd., Hayes, Middlesex, England
Electric Specialty Co., 211 South St., Stamford, Conn.
Fasco Industries, Inc., Rochester 2, N. Y.
Gale-Dorothea Mechanisms, Inc., 81–01 Broadway, Elmhurst, N. Y.
Holtzer-Cabot Div. of National Pneumatic Co., 130 Amory St., Boston 19, Mass.
Howard Industries, Inc., Divisions: Cyclohm Motor Corp., Electric Motor Corp., Racine, Wis.
Leland Electric Co., The, Div. of American Machine & Foundry Co., 1501 Webster St., Dayton 1, Ohio
MINNEAPOLIS-HONEYWELL REGULATOR CO., Wayne & Roberts Aves., Philadelphia 44, Pa. ADV. PG. 29
Mission Electric Mfg. Co., Inc., 132–134 W. Colorado, Pasadena 1, Calif.
Motoresearch Co., 1600 Junction Ave., Racine, Wis.
Red Bank Division, Bendix Aviation Corp., Eatontown, N. J.
Redmond Co., Inc., Owosso, Mich.
Rotron Mfg. Co., 7 Schoonmaker Lane, Woodstock, N. Y.
Small Motors, Inc., 2076 Elston Ave., Chicago 14, Ill.
Unified Pressed Products Co., 741 W. Harrison St., Chicago 7, Ill.
Wincharger Corp., E., 7th & Division Sts., Sioux City, Iowa

MOTORS—DC-FH

Air Associates, Inc., Teterboro, N. J.
Atlas Coil Winders, Inc., 392 State St., Stamford, Conn.
Bogue Electric Mfg. Co., 52 Iowa Ave., Paterson 3, N. J.
Century Electric Co., 1806 Pine St., St. Louis 3, Mo.
Dayton Electric Mfg. Co., 748 W. Adams, Chicago, Ill.
Electric & Musical Industries, Ltd., Hayes, Middlesex, England
Electric Specialty Co., 211 South St., Stamford, Conn.
Fasco Industries, Inc., Rochester 2, N. Y.
Globe Industries, Inc., 125 Sunrise Place, Dayton 7, Ohio
Gothard Mfg. Co., 2110 Clear Lake Ave., Springfield, Ill.
Holtzer-Cabot Div. of National Pneumatic Co., 130 Amory St., Boston 19, Mass.
Howard Industries, Inc., Divisions: Cyclohm Motor Corp., Electric Motor Corp., Racine, Wis.
Leland Electric Co., The, Div. of American Machine & Foundry Co., 1501 Webster St., Dayton 1, Ohio
Mission Electric Mfg. Co., Inc., 132–134 W. Colorado, Pasadena 1, Calif.
Motoresearch Co., 1600 Junction Ave., Racine, Wis.
Pacific Division, Bendix Aviation Corp., 11600 Sherman Way, North Hollywood, Calif.
Red Bank Division, Bendix Aviation Corp., Eatontown, N. J.
Redmond Co., Inc., Owosso, Mich.
Rotron Mfg. Co., 7 Schoonmaker Lane, Woodstock, N. Y.
Small Motors, Inc., 2076 Elston Ave., Chicago 14, Ill.
Specialty Battery Co., Madison 4, Wis.
Wincharger Corp., E., 7th & Division Sts., Sioux City, Iowa

MOTORS—Servo

American Electric Motors, Inc., 4811 Telegraph Rd., Los Angeles, Calif.
Atlas Coil Winders, Inc., 392 State St., Stamford, Conn.
Bogue Electric Mfg. Co., 52 Iowa Ave., Paterson 3, N. J.
Daekcan Corp., 56 Elmwood St., Newton, Mass.
Eastern Air Devices Inc., 585 Dean St., Brooklyn 17, N. Y.
Eclipse-Pioneer Div., Bendix Aviation Corp., Teterboro, N. J.
Electric Specialty Co., 211 South St., Stamford, Conn.
Ford Instrument Co., 31–10 Thomson Ave., Long Island City, N. Y.
G-M Laboratories Inc., 4336 N. Knox Ave., Chicago 41, Ill.
Globe Industries, Inc., 125 Sunrise Place, Dayton 7, Ohio
Holtzer-Cabot Div. of National Pneumatic Co., 130 Amory St., Boston 19, Mass.
Howard Industries, Inc., Divisions: Cyclohm Motor Corp., Electric Motor Corp., Racine, Wis.
Kollsman Instrument Corp., 80–08 45th Ave., Elmhurst, N. Y.
Minneapolis-Honeywell Regulator Co., 2753 Fourth Ave. S., Minneapolis, Minn.
MINNEAPOLIS-HONEYWELL REGULATOR CO., Wayne & Roberts Aves., Philadelphia 44, Pa. ADV. PG. 29

Mission Electric Mfg. Co., Inc., 132–134 W. Colorado, Pasadena 1, Calif.
Muirhead & Co., Ltd., Beckenham, Kent, England
Pacific Division, Bendix Aviation Corp., 11600 Sherman Way, North Hollywood, Calif.
SERVOMECHANISMS, INC., Post & Stewart Aves., Westbury, N. Y. ADV. PG. 109
Small Motors, Inc., 2076 Elston Ave., Chicago 14, Ill.
TRANSICOIL CORP., 107 Grand St., New York 13, N. Y. ADV. PG. 17
Westinghouse Electric Corp., P. O. Box 868, Pittsburgh 30, Pa.
Wincharger Corp., E., 7th & Division Sts., Sioux City, Iowa

NEUTRON SOURCES

ATOMIC ENERGY OF CANADA, LTD., Commercial Products Div., P. O. Box 93, Ottawa, Ontario, Canada. ADV. PG. 18
Atomlab, Inc., 489 Fifth Ave., New York 17, N. Y.
CANADIAN RADIUM & URANIUM CORP., 630 Fifth Ave., New York 20, N. Y. ADV. PG. 116
Electro-Mechanical Research, Inc., 64 Main St., Ridgefield, Conn.
HIGH VOLTAGE ENGINEERING CORP., 7 University Rd., Cambridge 38, Mass. ADV. PG. 20
Radium Chemical Co., 161 E. 42nd St., New York 17, N. Y.
TECHNICAL OPERATIONS, INC., 6 Schouler Court, Arlington 74, Mass. ADV. PG. 128
U. S. Radium Corp., 535 Pearl St., New York 7, N. Y.

NITROMETERS—Micro

Fisher Scientific Co., 709 Forbes St., Pittsburgh 19, Pa.
KONTES GLASS CO., Spruce St., Vineland, N. J. ADV. PG. 126
Scientific Glass Apparatus Co., Inc., 100 Lakewood Terrace, Bloomfield, N. J.

OBJECTIVES—Achromatic

American Optical Co., Instrument Div., Buffalo 15, N. Y.
Buhl Optical Co., 1009 Beech Ave., Pittsburgh 12, Pa.
Ferner Co., R. Y., 110 Pleasant St., Malden, Mass.
Gaertner Scientific Corp., 1237 Wrightwood Ave., Chicago, Ill.
Jarrell-Ash Co., 165 Newberry St., Boston 16, Mass.
LEITZ, INC., E., 304 Hudson St. at Spring St., New York 13, N. Y. ADV. PG. 121
Perkin-Elmer Corp., Norwalk, Conn.
Phoenix Precision Instrument Co., 3803–05 N. 5th St., Philadelphia, Pa.
Tinsley Laboratories, Inc., 2526 Grove St., Berkeley 4, Calif.
Yonkers Laboratory Supply Co., 70 Palisade Ave., Yonkers 2, N. Y.

OHMMETERS

Allied Radio Corp., 833 W. Jackson Blvd., Chicago 7, Ill.
American Chronoscope Corp., 316 W. First St., Mt. Vernon, N. Y.
Associated Research Inc., 3788 W. Belmont, Chicago, Ill.
Baldwin Instrument Co., Ltd., Brooklands Works, Dartford, Kent, England
Biddle Co., James G., 1316 Arch St., Philadelphia 7, Pa.
Cole Instrument Co., 1320 S. Grand Ave., Los Angeles 15, Calif.
Dice Co., J. W., Englewood, N. J.
Douglas Radio Labs., 176 Norfolk Ave., Boston 19, Mass.
Esterline-Angus Co., Inc., P. O. Box 596, Indianapolis, Ind.
Feller Engineering & Mfg. Co., 8026 N. Monticello Ave., Skokie, Ill.
GENERAL ELECTRIC CO., Apparatus Sales Div., Schenectady 5, N. Y. ADV. PGS. 2–5
Heath Co., Benton Harbor, Mich.
Hickok Electrical Instrument Co., 10514 Dupont Ave., Cleveland 8, Ohio
Hivolt Ltd., 34A Pottery Lane, London, W. 11, England
International Instruments, Inc., P. O. Box 2954, New Haven 15, Conn.
Leland Instruments Ltd., 22–23 Millbank, London, S. W. 1, England
Marion Electrical Instrument Co., 402 Canal St., Manchester, N. H.
Martindale Electric Co., 1375 Hird Ave., Cleveland 7, Ohio
Measurement Engineering Ltd., Arnprior, Ontario, Canada
Metropolitan Electronics & Instruments Co., 106 Fifth Ave., New York 11, N. Y.
Oak Ridge Products Mfg. Div., Video Television, Inc., 37–01 Vernon Blvd., Long Island City 1, N. Y.
Phaostron Co., 151 Pasadena Ave., South Pasadena, Calif.
Precision Apparatus Co., Inc., 92–27 Horace Harding Blvd., Elmhurst, N. Y.
Precision Electronics, 643 Milwaukee Ave., Chicago 22, Ill.
Radio City Products Co., Inc., 152 W. 25th St., New York 1, N. Y.
Shallcross Mfg. Co., 10 Jackson Ave., Collingdale, Pa.
Shurite Meters, 35 Hamilton St., New Haven 8, Conn.
Simpson Electric Co. Div., American Gage & Machine Co., 5208 W. Kinzie St., Chicago 44, Ill.
Square Root Mfg. Corp., 391 Saw Mill River Rd., Yonkers, N. Y.
Stickt Co., Inc., Herman H., 27 Park Place, New York 7, N. Y.
Sun Electric Corp., 6323 Avondale Ave., Chicago 31, Ill.
Supreme, Inc., Greenwood, Miss.
T. L. G. Electric Corp., 31 W. 27th St., New York 1, N. Y.
Telectro Industries Corp., 35–18 37th St., Long Island City 1, N. Y.
Triplett Electrical Instrument Co., 286 Harmon Rd., Bluffton, Ohio
Welch Scientific Co., W. M., 1515 Sedgwick St., Chicago 10, Ill.
WESTON ELECTRICAL INSTRUMENT CORP., 614 Frelinghuysen Ave., Newark 5, N. J. ADV. PG. 102
Weston Laboratories, Weston 93, Mass.
Winslow Co., Inc., 9 Liberty St., Newark, N. J.

OPTICAL INSTRUMENTS

American Optical Co., Instrument Div., Buffalo 15, N. Y.
Austin Co., Special Devices Div., 76 Ninth Ave., New York 11, N. Y.
Baird Associates, Inc., 33 University Rd., Cambridge 38, Mass.
Bausch & Lomb Optical Co., 630 St. Paul St., Rochester 2, N. Y.
Buhl Optical Co., 1009 Beech Ave., Pittsburgh 12, Pa.
Central Scientific Co., 1700 Irving Park Rd., Chicago 13, Ill.
Eastman Kodak Co., Rochester 4, N. Y.
Farrand Optical Co., Bronx Blvd. at E. 238th St., New York 70, N. Y.
Ferner Co., R. Y., 110 Pleasant St., Malden, Mass.
Fisher Scientific Co., 709 Forbes St., Pittsburgh 19, Pa.
Gaertner Scientific Corp., 1237 Wrightwood Ave., Chicago, Ill.
Jarrell-Ash Co., 165 Newberry St., Boston 16, Mass.
LEITZ, INC., E., 304 Hudson St. at Spring St., New York 13, N. Y. ADV. PG. 121
Maurer, Inc., J. A., 37–01 31st St., Long Island City, N. Y.
PENBERTHY INSTRUMENT CO., HI-D DIVISION, 666 Adams St., Seattle 8, Wash. ADV. PGS. 127, 134
Perkin-Elmer Corp., Norwalk, Conn.
Phoenix Precision Instrument Co., 3803–05 North 5th St., Philadelphia, Pa.
Process & Instruments, 60 Greenpoint Ave., Brooklyn 22, N. Y.
SCIENTIFIC SPECIALTIES CORP., Snow & Union Sts., Brighton 35, Mass. ADV. PG. 122
Tinsley Laboratories, Inc., 2526 Grove St., Berkeley 4, Calif.
UNITED STATES TESTING CO., Hoboken, N. J. ADV. PG. 114
Welch Scientific Co., W. M., 1515 Sedgwick St., Chicago 10, Ill.
Williams, Brown & Earle, Inc., 918 Chestnut St., Philadelphia 7, Pa.
Yonkers Laboratory Supply Co., 70 Palisade Ave., Yonkers 2, N. Y.
Zeiss, Inc., Carl, 485 Fifth Ave., New York 17, N. Y.

OSCILLOGRAPHS

Brush Development Co., 3405 Perkins Ave., Cleveland 14, Ohio
CAMBRIDGE INSTRUMENT CO., INC., 3756 Grand Central Terminal, New York 17, N. Y. ADV. PG. 123
CENTRAL RESEARCH LABORATORIES, INC., Red Wing, Minn. ADV. PG. 118
Cinema Television Ltd., Worsley Bridge Rd., London, S. E. 26, England
Consolidated Engineering Corp., 300 N. Sierra Madre Villa, Pasadena 8, Calif.
DuMont Labs., Inc., Allen B., 1000 Main Ave., Clifton, N. J.
Edin Co., Inc., 207 Main St., Worcester, Mass.
Electric & Musical Industries Ltd., Hayes, Middlesex, England
Electro-Medical Lab., Inc., South Woodstock 6, Vt.
Electrofax Co., 30 Burtis Ave., New Canaan, Conn.
GENERAL ELECTRIC CO., Apparatus Sales Div., Schenectady 5, N. Y. ADV. PGS. 2–5
Leland Instruments Ltd., 22–23 Millbank, London, S. W. 1, England
Maurer, Inc., J. A., 37–01 31st St., Long Island City, N. Y.
Measurement Engineering Ltd., Arnprior, Ontario, Canada
Metropolitan Electronics & Instruments Co., 106 Fifth Ave., New York 11, N. Y.
Miller Corp., William, 325 N. Halstead Ave., Pasadena 8, Calif.
Precision Apparatus Co., Inc., 92–27 Horace Harding Blvd., Elmhurst, N. Y.
Rendel Engineering, 2351 Riverside Drive, Los Angeles 39, Calif.
SANBORN CO., 39 Osborn St., Cambridge 39, Mass. ADV. PG. 92
Serve Corp. of America, 2020 Jericho Turnpike, New Hyde Park, N. Y.
Southwestern Industrial Electronics Co., 2831 Post Oak Rd., P. O. Box 13058, Houston 19, Texas
Western Sound & Electric Labs., Inc., 805 S. Fifth St., Milwaukee 4, Wis.
Westinghouse Electric Corp., P. O. Box 868, Pittsburgh 30, Pa.

OSCILLOSCOPES

Cinema Television Ltd., Worsley Bridge Rd., London, S. E. 26, England
DuMont Labs., Inc., Allen B., 1000 Main Ave., Clifton, N. J.
Electric & Musical Industries Ltd., Hayes, Middlesex, England
El-Tronics, Inc., 2649 N. Howard St., Philadelphia 33, Pa.
FURST ELECTRONICS, 3322A W. Lawrence Ave., Chicago 25, Ill. ADV. PG. 110
General Electric Co., Electronics Div., Electronics Park, Syracuse, N. Y.
Hickok Electrical Instrument Co., The, 10514 Dupont Ave., Cleveland 8, Ohio
LABORATORY FOR ELECTRONICS, INC., 43 Leon St., Boston 15, Mass. ADV. PG. 15
Lavoie Laboratories, Morganville, N. J.
Leland Instruments Ltd., 22–23 Millbank, London, S. W. 1, England
Measurement Engineering Ltd., Arnprior, Ontario, Canada
Metropolitan Electronics & Instruments Co., 106 Fifth Ave., New York 11, N. Y.
Mullard Overseas, Ltd., Century House, Shaftesbury Ave., London W. C. 2, England
Radio City Products Co., Inc., 152 W. 25th St., New York 1, N. Y.
Rendel Engineering, 2351 Riverside Drive, Los Angeles 39, Calif.
Simpson Electric Co. Div. of American Gage & Machine Co., 5208 W. Kinzie St., Chicago 44, Ill.
SPENCER-KENNEDY LABS., INC., 186 Massachusetts Ave., Cambridge 39, Mass. ADV. PG. 12
Square Root Mfg. Corp., 391 Saw Mill River Rd., Yonkers, N. Y.
Sylvania Electric Products, Inc., 1740 Broadway, New York 19, N. Y.
Tektronix, Inc., P. O. Box 831, Portland 7, Ore.
Television Equipment Corp., 338 William St., New York, N. Y.
WATTERMAN PRODUCTS CO., INC., 2245–63 Emerald St., Philadelphia 25, Pa. ADV. PGS. 6, 7
Western Sound & Electric Labs., Inc., 805 S. Fifth St., Milwaukee 4, Wis.

OSCILLOSCOPES—Cathode Ray

Airmec Laboratories, Ltd., High Wycombe, Buckinghamshire, England
Allied Radio Corp., 833 W. Jackson Blvd., Chicago 7, Ill.
American Electronic Laboratories, Inc., 641 Arch St., Philadelphia 6, Pa.
BETA ELECTRIC CORP., 333 E. 103rd St., New York 29, N. Y. ADV. PG. 120
Browning Laboratories, Inc., Winchester, Mass.
CAMBRIDGE INSTRUMENT CO., INC., 3756 Grand Central Terminal, New York 17, N. Y. ADV. PG. 123
Cinema-Television, Ltd., Worsley Bridge Rd., London, S. E. 26, England
Cossor (Canada) Ltd., 301 Windsor St., Halifax, N. S., Canada
Daylight Vacuum Products Co., 5207 N. Milwaukee Ave., Chicago 30, Ill.
Douglas Radio Labs., 176 Norfolk Ave., Boston 19, Mass.
Du Mont Labs., Inc., Allen B., Instrument Div., 1000 Main Ave., Clifton, N. J.
Electric & Musical Industries Ltd., Hayes, Middlesex, England
Electronic Instrument Co., Inc., 276 Newport St., Brooklyn 12, N. Y.
Electronic Tube Corp., 1200 E. Mermaid Lane, Philadelphia 18, Pa.
El-Tronics, Inc., 2649 N. Howard St., Philadelphia 33, Pa.
Fleming Radio Ltd., 18–20 Leystell St., London, E. C. 1, England
FURST ELECTRONICS, 3322A W. Lawrence Ave., Chicago 25, Ill. ADV. PG. 110
General Electric Co., Electronics Div., Electronics Park, Syracuse, N. Y.
Heath Co., Benton Harbor, Mich.
Hickok Electrical Instrument Co., The, 10514 Dupont Ave., Cleveland 8, Ohio

LABORATORY FOR ELECTRONICS, INC., 43 Leon St., Boston 15, Mass. ADV. PG. 15
Lavoie Laboratories, Morganville, N. J.
Leland Instruments Ltd., 22–23 Millbank, London, S. W. 1, England
Marconi Instruments, Ltd., 23–25 Beaver St., New York 4, N. Y.
Measurement Engineering Ltd., Arnprior, Ontario, Canada
Metropolitan Electronics & Instruments Co., 106 Fifth Ave., New York 11, N. Y.
Millen Mfg. Co., James, 150 Exchange St., Malden, Mass.
Mullard Overseas Ltd., Century House, Shaftesbury Ave., London W. C. 2, England
Precision Apparatus Co., Inc., 92–27 Horace Harding Blvd., Elmhurst, N. Y.
Radio City Products Co., Inc., 152 W. 25th St., New York 1, N. Y.
RADIO CORP. OF AMERICA, TUBE DEPT., Harrison, N. J. ADV. PG. 93
Rasdel Engineering, 2351 Riverside Drive, Los Angeles 39, Calif.
Simpson Electric Co., Div. of American Gage & Machine Co., 5208 W. Kinzie St., Chicago 44, Ill.
SPENCER-KENNEDY LABS., INC., 186 Massachusetts Ave., Cambridge 39, Mass. ADV. PG. 12
Supreme, Inc., Greenwood, Miss.
Sylvania Electric Products, Inc., 1740 Broadway, New York 19, N. Y.
Tektronix, Inc., P. O. Box 831, Portland 7, Ore.
Telechrome, Inc., 88 Merrick Road, Amityville, N. Y.
Telotronics Laboratory, Inc., Kinkel St., Westbury, N. Y.
Television Equipment Corp., 238 William S., New York, N. Y.
Triplett Electrical Instrument Co., 286 Harmon Rd., Bluffton, Ohio
Twentieth Century Electronics, Ltd., Dunbar Works, Dunbar St., West Norwood, London, S. E. 27, England
WATERMAN PRODUCTS CO., INC., 2445–63 Emerald St., Philadelphia 25, Pa. ADV. PGS. 6, 7
Western Sound & Electric Labs., Inc., 805 S. Fifth St., Milwaukee 4, Wis.
Weston Laboratories, Weston 93, Mass.

OVENS—Constant Temperature

Boekel & Co., Inc., Wm., 509–519 Vine St., Philadelphia 6, Pa.
Central Scientific Co., 1700 Irving Park Rd., Chicago 13, Ill.
Colloid Equipment Co., Inc., 50 Church St., New York 7, N. Y.
Daylight Vacuum Products Co., 5207 N. Milwaukee Ave., Chicago 30, Ill.
Electric Heat Control Apparatus Co., 27 N. J. R. R. Ave., Newark 5, N. J.
Electric Hotpack Co., Inc., 5035 Cottman Ave., Philadelphia, Pa.
Fisher Scientific Co., 709 Forbes St., Pittsburgh 19, Pa.
Grieve-Hendry Co., 1101 N. Paulina St., Chicago, Ill.
Humboldt Mfg. Co., 2814 N. Whipple St., Chicago 47, Ill.
Huppert Co., K. H., 6835 S. Cottage Grove Ave., Chicago 37, Ill.
National Appliance Co., Swan Island, Portland 18, Ore.
Phipps & Bird, Inc., 303 S. 6th St., Richmond 5, Va.
Precision Scientific Co., 3737 W. Cortland St., Chicago 47, Ill.
Process & Instruments, 60 Greenpoint Ave., Brooklyn 22, N. Y.
Radioisotope Application Co., 1843 University Ave., Berkeley 3, Calif.
Rockwell Co., W. S., 200 Eliot St., Fairfield, Conn.
Sargent & Co., E. H., 4647 W. Foster Ave., Chicago 30, Ill.
Scientific Service, Inc., 1417 Solano Ave., Albany, Calif.
Tenney Engineering, Inc., 26 Avenue B, Newark 5, N. J.
Yonkers Laboratory Supply Co., 70 Palisade Ave., Yonkers 2, N. Y.

OVENS—Laboratory

Acme Electric Heating Co., Inc., 1205 Washington St., Boston, Mass.
American Instrument Co., Inc., 8030 Georgia Ave., Silver Spring, Md.
Boekel & Co., Inc., Wm., 509–519 Vine St., Philadelphia 6, Pa.
Central Scientific Co., 1700 Irving Park Rd., Chicago 13, Ill.
Colloid Equipment Co., Inc., 50 Church St., New York 7, N. Y.
Cooper Co., D. C., 1467 S. Michigan Ave., Chicago, Ill.
Daylight Vacuum Products Co., 5207 N. Milwaukee Ave., Chicago 30, Ill.
Elmer & Amend Div. of Fisher Scientific Co., 635 Greenwich St., New York, N. Y.
Electric Heat Control Apparatus Co., 247 N. J. R. R. Ave., Newark 5, N. J.
Electric Hotpack Co., Inc., 5035 Cottman Ave., Philadelphia, Pa.
Fisher Scientific Co., 709 Forbes St., Pittsburgh 19, Pa.
Grieve-Hendry Co., 1101 N. Paulina St., Chicago, Ill.
Hommel Co., O., 209–213 Fourth Ave., Pittsburgh, Pa.
Humboldt Mfg. Co., 2814 N. Whipple St., Chicago 47, Ill.
Huppert Co., K. H., 6835 S. Cottage Grove Ave., Chicago 37, Ill.
National Appliance Co., Swan Island, Portland 18, Ore.
Phipps & Bird, Inc., 303 S. 6th St., Richmond 5, Va.
Precision Scientific Co., 3737 W. Cortland St., Chicago 47, Ill.
Rockwell Co., W. S., 200 Eliot St., Fairfield, Conn.
Sargent & Co., E. H., 4647 W. Foster Ave., Chicago 30, Ill.
Thomas Co., Arthur H., W. Washington Square, Philadelphia 5, Pa.
UNITED STATES TESTING CO., Hoboken, N. J. ADV. PG. 114
Yonkers Laboratory Supply Co., 70 Palisade Ave., Yonkers 2, N. Y.

OVENS—Vacuum

American Instrument Co., Inc., 8030 Georgia Ave., Silver Spring, Md.
Bowser Technical Refrigeration Div., Bowser, Inc., Terryville, Conn.
Central Scientific Co., 1700 Irving Park Rd., Chicago 13, Ill.
DISTILLATION PRODUCTS INDUSTRIES, A Division of Eastman Kodak Co., Rochester 3, N. Y. ADV. PG. 91
Daylight Vacuum Products Co., 5207 N. Milwaukee Ave., Chicago 30, Ill.
Elsier Engineering Co., 760 S. 13th St., Newark 3, N. J.
Electric Heat Control Apparatus Co., 27 N. J. R. R. Ave., Newark 5, N. J.
Electric Hotpack Co., Inc., 5035 Cottman Ave., Philadelphia, Pa.
National Appliance Co., Swan Island, Portland 18, Ore.
NATIONAL RESEARCH CORP., 70 Memorial Drive, Cambridge 42, Mass. ADV. PG. 16
OPTICAL FILM ENGINEERING CO., 2731–37 N. 6th St., Philadelphia 33, Pa. ADV. PG. 106
Precision Scientific Co., 3737 W. Cortland St., Chicago 47, Ill.
STOKES MACHINE CO., F. J., Frankford Station P. O., Philadelphia 20, Pa. ADV. PG. 117
Tenney Engineering, Inc., 26 Avenue B, Newark 5, N. J.
Will Corp., Rochester 3, N. Y.
Yonkers Laboratory Supply Co., 70 Palisade Ave., Yonkers 2, N. Y.

PAINTS—Protective

American Products Mfg. Co., Inc., 8127–33 Oleander St., New Orleans 18, La.
Arco Co., The, 7301 Bessemer Ave., Cleveland 27, Ohio
Atlas Mineral Products Co., 131 Norman St., Mertztown, Pa.
Carbeline Co., 7603 Forsythe Blvd., St. Louis 5, Mo.
Corrosite Corp., Chrysler Bldg., New York 17, N. Y.
Devoe & Raynolds Co., Inc., 787 First Ave., New York, N. Y.
du Pont de Nemours & Co., Inc., E. I., Wilmington 98, Del.
Eagle-Picher Co., Cincinnati, Ohio
Electro Chemical Supply & Engineering Co., 750 Broad St., Emmaus, Pa.
General Cement Co., 919 Taylor Ave., Rockford, Ill.
Glidden Co., 11001 Madison Ave., Cleveland 2, Ohio
Highside Chemicals Co., 10 Colfax Ave., Clifton, N. J.
Horn Co., Inc., A. C., 10th St. & 44th Ave., Long Island City 1, N. Y.
Houghton Laboratories, Inc., 322 Bush St., Olean, N. Y.
Howe & French, Inc., 99 Broad St., Boston 10, Mass.
Inertol Co., Inc., 480 Frelinghuysen Ave., Newark 5, N. J.
Irvington Varnish & Insulator Co., 6 Argyle Terrace, Irvington, N. J.
Knight, Maurice A., 171 Kelly Ave., Akron, Ohio
Maas & Waldstein Co., 438 Riverside Ave., Newark 4, N. J.
Micro-Circuits Co., New Buffalo, Mich.
Mitchell-Rand Insulation Co., Inc., 51 Murray St., New York 7, N. Y.
National Lead Co., 111 Broadway, New York 6, N. Y.
Nukem Products Corp., 111 Colgate Ave., Buffalo 20, N. Y.
Sauereisen Cements Co., Sauereisen Bldg., Pittsburgh 15, Pa.
United Chromium, Inc., 100 East 42nd St., New York, N. Y.
U. S. Stoneware Co., Akron 9, Ohio
Varnitan Co., 416 N. Verney St., Burbank, Calif.

PANELS & WALLBOARD

Armstrong Cork Co., 1010 Concord St., Lancaster, Pa.
BAR-RAY PRODUCTS, INC., 209 25th St., Brooklyn 32, N. Y. ADV. PG. 112
Insuline Corp. of America, 36–02 35th Ave., Long Island City, N. Y.
Penn Fibre & Specialty Co., 2020 E. Westmoreland St., Philadelphia 34, Pa.
Technical Ply-Woods, 228 N. LaSalle St., Chicago, Ill.

PHOSPHORS—Scintillation

American Products Mfg. Co., Inc., 8127–33 Oleander St., New Orleans 18, La.
CANADIAN RADIUM & URANIUM CORP., 630 Fifth Ave., New York 20, N. Y. ADV. PG. 116
COLE, LTD., E. K., Electronics Div., Malmesbury, Wiltshire, England. ADV. PG. 28
DISTILLATION PRODUCTS INDUSTRIES, A Division of Eastman Kodak Co., Rochester 3, N. Y. ADV. PG. 91
Harshaw Scientific, Div. of Harshaw Chemical Co., 1945 E. 97th St., Cleveland 6, Ohio
Linde Air Products Co., Div. of Union Carbide & Carbon Corp., 30 E. 42nd St., New York 17, N. Y.
Macdonald Co., Inc., W. S., 33 University Rd., Cambridge 38, Mass.
NATIONAL RADIAC, INC., 10 Crawford St., Newark 2, N. J. ADV. PG. 126
NUCLEAR RESEARCH CORP., 2543 Grays Ferry Ave., Philadelphia 46, Pa. ADV. PG. 97
NUCLEAR RESEARCH & DEVELOPMENT INC., 1094 Sutter Ave., St. Louis, Mo. ADV. PG. 103
Patterson, Moos & Co., Inc., 32–36 47th Ave., Long Island City 1, N. Y.
Pilot Chemicals Inc., 47 Felton St., Waltham 54, Mass.
R-C SCIENTIFIC INSTRUMENT CO., 335 Culver Blvd., Playa Del Rey, Calif. ADV. PG. 129
Radiation Counter Labs., Inc., 1844 W. 21st St., Chicago 8, Ill.
Standard Electronics Research Corp., 2 East End Ave., New York 21, N. Y.
TRACERLAB, INC., 130 High St., Boston 10, Mass. ADV. PG. 24
Wood Counter Laboratory, H., 5491 Blackstone, Chicago 15, Ill.

PHOTOGRAPHIC MATERIALS—Films and Papers for Recording Instruments

Ansco Division, General Aniline & Film Corp., Binghamton, N. Y.
Berndt-Bach, Inc., 7377 Beverly Blvd., Los Angeles 36, Calif.
Consolidated Engineering Corp., 300 N. Sierra Madre Villa, Pasadena 8, Calif.
du Pont de Nemours & Co., Inc., E. I., Wilmington 98, Delaware
Eastman-Kodak Co., Rochester 4, N. Y.
LUDWIG ASSOCIATES, F. G., 304 High St., Deep River, Conn. ADV. PG. 127
Maurer, Inc., J. A., 37–01 31st St., Long Island City, N. Y.
Miller Corp., William, 325 N. Halstead Ave., Pasadena 8, Calif.

PHOTOGRAPHIC MATERIALS—Spectrographic Instruments

BURKE & JAMES, INC., 321 S. Wabash Ave., Chicago 4, Ill. ADV. PG. 133
Eastman-Kodak Co., Rochester 4, N. Y.
Jarrell-Ash Co., 165 Newberry St., Boston 16, Mass.
National Spectrographic Labs., Inc., 6300 Euclid Ave., Cleveland 3, Ohio

PHOTOGRAPHIC PLATES & FILM—Nuclear

Eastman-Kodak Co., Rochester 4, N. Y.
Jarrell-Ash Co., 165 Newberry St., Boston 16, Mass.
Minimax Co., 5905 N. Clark St., Chicago 26, Ill.
Powers X-Ray Products Inc., Glen Cove, N. Y.

PHOTOMETERS—Electric

American Instrument Co., Inc., 8030 Georgia Ave., Silver Spring, Md.
Avion Instrument Corp., Paramus, N. J.
Baldwin Instrument Co., Ltd., Brooklands Works, Dartford, Kent, England
Electronic Control Corp., 1573 E. Forest St., Detroit 7, Mich.

Electro-Physics Corp., 287 Broadway, New York 7, N. Y.
Farrand Optical Co., Inc., Bronx Blvd. at E. 238th St., New York 70, N. Y.
Fisher Scientific Co., 709 Forbes St., Pittsburgh 19, Pa.
Leeds & Northrup Co., 4970 Stenton Ave., Philadelphia 44, Pa.
Phoenix Precision Instrument Co., 3803–05 North 5th St., Philadelphia, Pa.
Photocon Research Products, 421 N. Foothill Blvd., Pasadena 7, Calif.
Rubicon Co., Ridge Ave. at 35th St., Philadelphia 32, Pa.
Telechrome, Inc., 88 Merrick Road, Amityville, N. Y.
Welch Scientific Co., W. M., 1515 Sedgwick St., Chicago 10, Ill.
WESTON ELECTRICAL INSTRUMENT CORP., 614 Frelinghuysen Ave., Newark 5, N. J. ADV. PG. 102

PHOTOMETERS—Flame

Baird Associates, Inc., 33 University Rd., Cambridge 38, Mass.
Baldwin Instrument Co., Ltd., Brooklands Works, Dartford, Kent, England
Beckman Instruments, Inc., 820 Mission St., South Pasadena 183, Calif.
Electronic Control Corp., 1573 E. Forest St., Detroit 7, Mich.
Perkin-Elmer Corp., Norwalk, Conn.
Phoenix Precision Instrument Co., 3803–05 N. 5th St., Philadelphia, Pa.
Process & Instruments, 60 Greenpoint Ave., Brooklyn 22, N. Y.

PHOTOMETERS—Light-Transmission

Baldwin Instrument Co., Ltd., Brooklands Works, Dartford, Kent, England
Central Scientific Co., 1700 Irving Park Rd., Chicago 13, Ill.
Coleman Instruments Inc., Maywood, Ill.
Electronic Control Corp., 1573 E. Forest St., Detroit 7, Mich.
Farrand Optical Co., Inc., Bronx Blvd. at E. 238th St., New York 70, N. Y.
Fisher Scientific Co., 709 Forbes St., Pittsburgh 19, Pa.
Gaertner Scientific Corp., 1237 Wrightwood Ave., Chicago, Ill.
Macbeth Corp., Cochaton Turnpike, P. O. Box 950, Newburgh, N. Y.
Perkin-Elmer Corp., Norwalk, Conn.
Phoenix Precision Instrument Co., 3803–05 North 5th St., Philadelphia, Pa.
Photovolt Corp., 95 Madison Ave., New York 16, N. Y.
Welch Scientific Instrument Co., W. M., 1515 Sedgwick St., Chicago 10, Ill.

PHOTOMICROGRAPHIC EQUIPMENT

Bausch & Lomb Optical Co., 630 St. Paul St., Rochester 2, N. Y.
Ferner Co., R. Y., 110 Pleasant St., Malden, Mass.
Jarrell-Ash Co., 165 Newberry St., Boston 16, Mass.
Photovolt Corp., 95 Madison Ave., New York 16, N. Y.
Maurer, Inc., J. A., 37–01 31st St., Long Island City, N. Y.

PIPE—Acid Proof

Coors Porcelain Co., Golden, Colo.
General Ceramics & Steatite Corp., 250 Crows Mill Road, Keasbey, N. J.
International Nickel Co., Inc., 67 Wall St., New York 5, N. Y.
Knight, Maurice A., 171 Kelly Ave., Akron, Ohio
Lapp Insulator Co., Inc., 31 Gilbert St., LeRoy, N. Y.
Pfaudler Co., 1002 West Ave., Rochester, N. Y.
U. S. Stoneware Co., Akron 9, Ohio

PIPE—Glass

Corning Glass Works, Corning, N. Y.
Fischer & Porter Co., 50 County Line Rd., Hatboro, Pa.
Hickey Inc., Fred S., 5041 W. Lake St., Chicago 44, Ill.
Phoenix Precision Instrument Co., 3803–05 North 5th St., Philadelphia, Pa.

PIPE—Hard Rubber

Goodyear Tire & Rubber Co., Akron, Ohio
Luzerne Rubber Co., Dewey St., Trenton, N. J.
U. S. Rubber Co., 1230 Avenue of the Americas, New York 20, N. Y.

PIPE—Metal

Allegheny Ludlum Steel Corp., 2020 Oliver Bldg., Pittsburgh 22, Pa.
Alloy Tube Division of Carpenter Steel Co., Union, N. J.
Alpha Metals, Inc., P. O. Box 34, 56 Water St., Jersey City, N. J.
Aluminum Co. of America, 801 Gulf Bldg., Pittsburgh, Pa.
American Brass Co., Waterbury 20, Conn.
American Smelting & Refining Co., 120 Broadway, New York 5, N. Y.
Asteli & Co., Inc., John B., 90 West Broadway, New York 7, N. Y.
Babcock & Wilcox Co., 161 E. 42nd St., New York 17, N. Y.
Belmont Smelting & Refining Works, Inc., 322 Belmont Ave., Brooklyn, N. Y.
Bethlehem Steel Co., Bethlehem, Pa.
Bristol Metal Products Corp., Bristol, Tenn.
Carpenter Steel Co., The, Reading, Pa.
Chase Brass & Copper Co., Waterbury, Conn.
Consolidated Siphon Supply Co., Inc., 24 Wooster St., New York, N. Y.
Day Co., The, 820 Third Ave., NE, Minneapolis 13, Minn.
Division Lead Co., 836 W. Kinzie St., Chicago 22, Ill.
Emerson-Sack-Warner Corp., 150 Dorchester Ave., South Boston 23, Mass.
Houston Blow Pipe & Sheet Metal Works, P. O. Box 1692, Houston 1, Texas
International Nickel Co., Inc., 67 Wall St., New York 5, N. Y.
National Lead Co., 111 Broadway, New York 6, N. Y.
Revere Copper & Brass, Inc., 230 Park Ave., New York 17, N. Y.

PIPE—Plastic

Anchor Plastics Co., Inc., 541 Canal St., New York 13, N. Y.
Atlas Mineral Products Co., 131 Norman St., Mertztown, Pa.
Consolidated Siphon Supply Co., Inc., 24 Wooster St., New York, N. Y.
General Ceramics & Steatite Corp., 250 Crows Mill Rd., Keasbey, N. J.
Houghton Laboratories, Inc., 322 Bush St., Olean, N. Y.
Irvington Varnish & Insulator Co., 10 Argyle Terrace, Irvington, N. J.
Knight, Maurice A., 171 Kelly Ave., Akron, Ohio
Pabst Engineering Equipment Co., Inc., Elizabeth, N. J.
Polymer Corp. of Penna., The, Reading, Pa.
Synthane Corp., River Road, Oaks, Pa.
U. S. GASKET CO., 602 N. 10th St., Camden, N. J. ADV. PG. 135
U. S. Plywood Corp., 55 W. 44th St., New York 18, N. Y.
U. S. Rubber Co., 1230 Avenue of the Americas, New York 20, N. Y.
U. S. Stoneware Co., Akron 9, Ohio

PIPETTES

Corning Glass Works, Corning, N. Y.
Daylight Vacuum Products Co., 5207 N. Milwaukee Ave., Chicago 30, Ill.
Fisher Scientific Co., 709 Forbes St., Pittsburgh 19, Pa.
Jasonais Chemical Corp., 1085 Myrtle Ave., Brooklyn 6, N. Y.
Kahl Scientific Instrument Corp., Box 1166, El Cajon, Calif.
KONTES GLASS CO., Spruce St., Vineland, N. J. ADV. PG. 126
Milwaukee Glass Works, Inc., 2338 N. 30th St., Milwaukee, Wis.
Polymer Corp. of Penna., The, Reading, Pa.
Radiation Counter Labs., Inc., 1844 W. 21st St., Chicago 8, Ill.
Radioisotope Application Co., 1843 University Ave., Berkeley 3, Calif.
Scientific Service, Inc., 1417 Solano Ave., Albany, Calif.
Special Glass Products Co., 2 W. 33rd St., New York, N. Y.
Yonkers Laboratory Supply Co., 70 Palisade Ave., Yonkers 2, N. Y.

PIPETTES—Automatic

Daylight Vacuum Products Co., 5207 N. Milwaukee Ave., Chicago 30, Ill.
Fisher Scientific Co., 709 Forbes St., Pittsburgh 19, Pa.
Kahl Scientific Instrument Corp., Box 1166, El Cajon, Calif.
KONTES GLASS CO., Spruce St., Vineland, N. J. ADV. PG. 126
Sargent & Co., E. H., 4647 W. Foster Ave., Chicago 30, Ill.
Scientific Glass Apparatus Co., Inc., 100 Lakewood Terrace, Bloomfield, N. J.
Special Glass Products Co., 2 W. 33rd St., New York, N. Y.
Will Corp., Rochester 3, N. Y.
Yonkers Laboratory Supply Co., 70 Palisade Ave., Yonkers 2, N. Y.

PLANCHETS

B-C SCIENTIFIC INSTRUMENT CO., 335 Culver Blvd., Playa Del Rey, Calif. ADV. PG. 129
Radiation Counter Labs., Inc., 1844 W. 21st St., Chicago 8, Ill.
TECHNICAL OPERATIONS, INC., 6 Schouler Court, Arlington 74, Mass. ADV. PG. 128
TRACERLAB, INC., 130 High St., Boston 10, Mass. ADV. PG. 24

PLASTICS—Laminated

Astra Plywood & Veneer Co., 1731 N. Elston Ave., Chicago 22, Ill.
American Products Mfg. Co., Inc., 8127–33 Oleander St., New Orleans 18, La.
BAR-RAY PRODUCTS, INC., 209 25th St., Brooklyn 32, N. Y. ADV. PG. 112
Continental-Diamond Fibre Co., Newark, Delaware
Emerson & Cuming Co., 126 Massachusetts Ave., Boston, Mass.
Falsenthal & Sons, Inc., G., 4100 W. Grand Ave., Chicago 51, Ill.
General Electric Co., Chemical Div., 1 Plastics Ave., Pittsfield, Mass.
Irvington Varnish & Insulator Co., 6 Argyle Terrace, Irvington, N. J.
Keller Products, Inc., Manchester, N. H.
Keystone Electronics Corp., 423 Broome St., New York 13, N. Y.
Knight, Maurice A., 171 Kelly Ave., Akron, Ohio
Mallory & Co., Inc., P. R., 3029 E. Washington St., Indianapolis 6, Ind.
National Vulcanized Fibre Co., Wilmington 99, Del.
Pabst Engineering Equipment Co., Inc., Elizabeth, N. J.
Penn Fibre & Specialty Co., 2020 E. Westmoreland St., Philadelphia 34, Pa.
Spaulding Fibre Co., Inc., 310 Wheeler St., Tonawanda, N. Y.
Synthane Corp., River Road, Oaks, Pa.
Technical Ply-Woods, 228 N. LaSalle St., Chicago, Ill.
U. S. GASKET CO., 602 N. 10th St., Camden, N. J. ADV. PG. 135
U. S. Plywood Corp., 55 W. 44th St., New York 18, N. Y.
U. S. Rubber Co., 1230 Avenue of the Americas, New York 20, N. Y.
Westinghouse Electric Corp., P. O. Box 868, Pittsburgh 30, Pa.

PLASTICS—Protective

American Products Mfg. Co., Inc., 8127–33 Oleander St., New Orleans 18, La.
Atlas Mineral Products Co., 131 Norman St., Mertztown, Pa.
BAR-RAY PRODUCTS, INC., 209 25th St., Brooklyn 32, N. Y. ADV. PG. 112
Carboline Co., 7603 Forsythe Blvd., St. Louis 5, Mo.
Celanese Chemical Corp., 180 Madison Ave., New York 16, N. Y.
du Pont de Nemours & Co., Inc., E. I., Wilmington 98, Del.
Emerson & Cuming Co., 126 Massachusetts Ave., Boston, Mass.
Falsenthal & Sons, Inc., G., 4100 W. Grand Ave., Chicago 51, Ill.
Gits Molding Corp., 4600 W. Huron St., Chicago 44, Ill.
Houghton Laboratories, Inc., 322 Bush St., Olean, N. Y.
Irvington Varnish & Insulator Co., 6 Argyle Terrace, Irvington, N. J.
Kellogg Co., M. W., Chemical Mfg. Div., P. O. Box 469, Jersey City 3, N. J.
Keystone Electronics Corp., 423 Broome St., New York 12, N. Y.
Mallory & Co., Inc., P. R., 3029 E. Washington St., Indianapolis 6, Ind.
Minnesota Mining & Mfg. Co., St. Paul 6, Minn.
Pabst Engineering Equipment Co., Inc., Elizabeth, N. J.
United Chromium, Inc., 100 East 42nd St., New York, N. Y.
U. S. GASKET CO., 602 N. 10th St., Camden, N. J. ADV. PG. 135

PLOTTERS—Electronic

Analex Corp., Concord, N. H.
Avion Instrument Corp., Paramus, N. J.
Hastings Instrument Co., Super Highway at Pine Ave., Hampton, Va.
Raytheon Mfg. Co., Equipment Sales Div., Waltham 54, Mass.
Readel Engineering, 2351 Riverside Drive, Los Angeles 39, Calif.
Servo Corp. of America, 2020 Jericho Turnpike, New Hyde Park, N. Y.
Vectron, Inc., 400 Main St., Waltham 54, Mass.

PLYWOOD—Metal-Clad

BAR-RAY PRODUCTS, INC., 209 25th St., Brooklyn 32, N. Y. ADV. PG. 112
Division Lead Co., 836 W. Kinzie St., Chicago 22, Ill.

POLARIZERS

Keller Products, Inc., Manchester, N. H.
Technical Ply-Woods, 228 N. LaSalle St., Chicago, Ill.
U. S. Plywood Corp., 55 W. 44th St., New York 18, N. Y.

POLARIZERS

Jarrell-Ash Co., 165 Newberry St., Boston 16, Mass.
Phoenix Precision Instrument Co., 3805-05 N. 5th St., Philadelphia, Pa.

POLAROGRAPHS

CAMBRIDGE INSTRUMENT CO., INC., 2786 Grand Central Terminal, New York 17, N. Y. ADV. PG. 123
Fisher Scientific Co., 709 Forbes St., Pittsburgh 19, Pa.
Sargent & Co., E. H., 4647 W. Foster Ave., Chicago 30, Ill.

POTENTIOMETERS

Allen-Bradley Co., 136 W. Greenfield Ave., Milwaukee 4, Wis.
Allied Radio Corp., 833 W. Jackson Blvd., Chicago 7, Ill.
Avion Instrument Corp., Paramus, N. J.
Borg Corp., George W., Borg Equipment Div., Janesville, Wis.
Bristol Co., The, Waterbury 20, Conn.
Brown Electro-Measurement Corp., 4637 SE Hawthorne Blvd., Portland 15, Ore.
Cinema Engineering Co., 1510 W. Verdugo Ave., Burbank, Calif.
Clarostat Mfg. Co., Inc., Dover, New Hampshire
COLE, LTD., E. K., Electronics Div., Malmesbury, Wiltshire, England. ADV. PG. 28
Cole Instrument Co., 1320 S. Grand Ave., Los Angeles 15, Calif.
Daven Co., 191 Central Ave., Newark 4, N. J.
DeJur-Amsco Corp., 45-01 Northern Blvd., Long Island City 1, N. Y.
Edcliff Instruments, 850 S. Fair Oaks Ave., Pasadena, Calif.
Electro-Mec Laboratory, 19 Murray St., New York 7, N. Y.
Fairchild Camera & Instrument Corp., 88-06 Van Wyck Blvd., Jamaica 1, N. Y.
Fisher Scientific Co., 709 Forbes St., Pittsburgh 19, Pa.
Ford Instrument Co., 31-10 Thomson Ave., Long Island City, N. Y.
Foxboro Co., 38 Neponset Ave., Foxboro, Mass.
General Radio Co., 275 Massachusetts Ave., Cambridge 39, Mass.
Gerator Corp., 1820 N. Nash St., Arlington, Va.
Giannini & Co., G. M., 254 W. Colorado St., Pasadena 1, Calif.
HELIPOT CORP., 916 Meridian Ave., South Pasadena, Calif. ADV. PG. 27
Leeds & Northrup Co., 4970 Stenton Ave., Philadelphia 44, Pa.
Mallory & Co., Inc., P. R., 3029 E. Washington St., Indianapolis 6, Ind.
Measurement Engineering Ltd., Arnprior, Ontario, Canada
MINNEAPOLIS-HONEYWELL REGULATOR CO., Wayne & Roberts Aves., Philadelphia 44, Pa. ADV. PG. 39
Ohmite Mfg. Co., 4835 W. Flournoy St., Chicago 44, Ill.
Pacific Division, Bendix Aviation Corp., 11600 Sherman Way, North Hollywood, Calif.
Phoenix Precision Instrument Co., 3803-05 N. 5th St., Philadelphia, Pa.
Rawson Electrical Instrument Co., 114 Potter St., Cambridge 42, Mass.
Rubicon Co., Ridge Ave. at 35th St., Philadelphia 32, Pa.
Shaltcross Mfg. Co., 10 Jackson Ave., Collingdale, Pa.
Sound Apparatus Co., Stirling, N. J.
Specialties, Inc., Skunks Misery Road, Syosset, N. Y.
Square Root Mfg. Corp., 391 Saw Mill River Rd., Yonkers, N. Y.
Stackpole Carbon Co., St. Mary's, Pa.
Tech Laboratories, Inc., Bergen & Edsall Blvds., Palisades Park, N. J.
Technology Instrument Corp., 531 Main St., Acton, Mass.
Thwing-Albert Instrument Co., Penn St. & Pulaski Ave., Philadelphia 44, Pa.
Vectron, Inc., 400 Main St., Waltham 54, Mass.
WESTON ELECTRICAL INSTRUMENT CORP., 614 Frelinghuysen Ave., Newark 5, N. J. ADV. PG. 102
Wheelco Instrument Co., 847 W. Harrison St., Chicago 7, Ill.

POWER SUPPLIES—High Voltage

Acme Electronics, Inc., 300 N. Lake Ave., Pasadena 4, Calif.
Airpax Products Co., Middle River, Baltimore 20, Md.
Allied Radio Corp., 833 W. Jackson Blvd., Chicago 7, Ill.
ATOMIC INSTRUMENT CO., 84 Massachusetts Ave., Cambridge 39, Mass. ADV. PG. 23
Atomlab, Inc., 489 Fifth Ave., New York 17, N. Y.
BETA ELECTRIC CORP., 333 E. 103rd St., New York 29, N. Y. ADV. PG. 120
Bogue Electric Mfg. Co., 52 Iowa Ave., Paterson 3, N. J.
Bracke-Seib X-Ray Co., 293 Third Ave., New York 10, N. Y.
Chatham Electronics Corp., 475 Washington St., Newark 2, N. J.
Cinema-Television Ltd., Worsley Bridge Rd., London S. E. 26, England
COLE, LTD., E. K., Electronics Div., Malmesbury, Wiltshire, England. ADV. PG. 28
Cole Instrument Co., 1320 S. Grand Ave., Los Angeles 15, Calif.
Cornell-Dubilier Electric Corp., South Plainfield, N. J.
Cosser (Canada) Ltd., 301 Windsor St., Halifax, N. S., Canada
Douglas Radio Labs., 176 Norfolk Ave., Boston 19, Mass.
Electronic Measurements Co., Inc., Lewis St. & Maple Ave., Eatontown, N. J.
El-Tronics, Inc., 2649 N. Howard St., Philadelphia 33, Pa.
Embassy Engineering Corp., 224 E. 204th St., New York 58, N. Y.
Essex Electronics, Springfield Ave., Berkeley Heights, N. J.
Federal Telephone & Radio Corp., 100 Kingsland Rd., Clifton, N. J.
Fluke Engineering Co., John, 1111 W. Nickerson St., Seattle 99, Wash.
Ford Instrument Co., 31-10 Thomson Ave., Long Island City, N. Y.
Freed Transformer Co., Inc., 1736 Weirfield St., Brooklyn 27, N. Y.
FURST ELECTRONICS, 3322A W. Lawrence Ave., Chicago 25, Ill. ADV. PG. 110
GENERAL ELECTRIC CO., Apparatus Sales Div., Schenectady 5, N. Y. ADV. PGS. 2-5
Hivolt Ltd., 36A Pottery Lane, London W. 11, England
Inet, Inc., 8655 S. Main St., Los Angeles 3, Calif.
International Rectifier Corp., 1521 E. Grand Ave., El Segundo, Calif.
Jowil Electronics Inc., 7945 Germantown Ave., Philadelphia 18, Pa.
KEPCO LABS., INC., 131-38 Sanford Ave., Flushing, N. Y. ADV. PGS. 10, 11
Langevin Mfg. Corp., 37 W. 65th St., New York 23, N. Y.
Macdonald Co., Inc., W. S., 33 University Rd., Cambridge 38, Mass.
MacLeod & Hanopol, Inc., 10 Roland St., Charlestown 29, Mass.
Mallory & Co., Inc., P. R., 3029 E. Washington St., Indianapolis 6, Ind.
Manson Laboratories, 207 Greenwich Ave., Stamford, Conn.
Measurement Engineering Ltd., Arnprior, Ontario, Canada
Mercury Electronic Co., Box 450, Red Bank, N. J.
Moulic Specialties Co., 1005 W. Washington St., Bloomington, Ill.
National Spectrographic Labs., Inc., 6300 Euclid Ave., Cleveland 3, Ohio
NEUTRONIC ASSOCIATES, 83-36 Victor Ave., Elmhurst 73, N. Y. ADV. PG. 101
Nuclear Measurements Corp., 2460 N. Arlington Ave., Indianapolis 18, Ind.
NUCLEAR RESEARCH CORP., 2563 Grays Ferry Ave., Philadelphia 46, Pa. ADV. PG. 97
NUCLEAR RESEARCH & DEVELOPMENT INC., 1094 Sutter Ave., St. Louis, Mo. ADV. PG. 103
Paschel Electronics, Inc., 13 Garden St., New Rochelle, N. Y.
Phoenix Precision Instrument Co., 3803-05 N. 5th St., Philadelphia, Pa.
Plastic Capacitors, Inc., 2511 W. Moffat St., Chicago 47, Ill.
Radiation Counter Labs., Inc., 1844 W. 21st St., Chicago 8, Ill.
RADIATION INSTRUMENT DEVELOPMENT LAB., 2337 W. 67th St., Chicago 36, Ill. ADV. PG. Inside Back Cover
RADIO CORP. OF AMERICA, RCA VICTOR DIV., ENGINEERING PRODUCTS DEPT., Front & Cooper Sts., Camden, N. J. ADV. PG. 13
Raytheon Mfg. Co., Equipment Sales Div., Waltham 54, Mass.
Red Bank Division, Bendix Aviation Corp., Eatontown, N. J.
Reedel Engineering, 2351 Riverside Drive, Los Angeles 39, Calif.
Scientific Electric Co., 107-119 Monroe St., Garfield, N. J.
SCIENTIFIC SPECIALTIES CORP., Snow & Union Sts., Brighton 35, Mass. ADV. PG. 122
Sherron Electronics Co., 1201 Flushing Ave., Brooklyn 6, N. Y.
Sierra Electronic Corp., San Carlos, Calif.
SORENSEN & CO., INC., 375 Fairfield Ave., Stamford, Conn. ADV. PG. 125
Spellman Television Co., Inc., 3029 Webster Ave., Bronx 67, N. Y.
Sperry Gyroscope Co., Great Neck, N. Y.
Square Root Mfg. Corp., 391 Saw Mill River Rd., Yonkers, N. Y.
T. L. G. Electric Corp., 31 W. 27th St., New York 1, N. Y.
Tech Laboratories, Inc., Bergen & Edsall Blvds., Palisades Park, N. J.
Telechrome, Inc., 88 Merrick Road, Amityville, N. Y.
VICTOREEN INSTRUMENT CO., 3800 Perkins Ave., Cleveland 14, Ohio. ADV. PG. Inside Front Cover
Weston Laboratories, Weston 93, Mass.

POWER SUPPLIES—Regulated

Acme Electronics, Inc., 300 N. Lake Ave., Pasadena 4, Calif.
Air Associates Inc., Teterboro, N. J.
Airmec Laboratories, Ltd., High Wycombe, Buckinghamshire, England.
Airpax Products Co., Middle River, Baltimore 20, Md.
American Electronic Laboratories, Inc., 641 Arch St., Philadelphia 6, Pa.
ANTON ELECTRONIC LABS., INC., 1226-38 Flushing Ave., Brooklyn 37, N. Y. ADV. PG. 136
ATOMIC INSTRUMENT CO., 84 Massachusetts Ave., Cambridge 39, Mass. ADV. PG. 23
Atomlab, Inc., 489 Fifth Ave., New York 17, N. Y.
Avion Instrument Corp., Paramus, N. J.
BETA ELECTRIC CORP., 333 E. 103rd St., New York 29, N. Y. ADV. PG. 120
Bogue Electric Mfg. Co., 52 Iowa Ave., Paterson 3, N. J.
Borg Corp., George W., Borg Equipment Div., Janesville, Wis.
Browning Laboratories, Inc., Winchester, Mass.
Chatham Electronics Corp., 475 Washington St., Newark 2, N. J.
Cinema-Television, Ltd., Worsley Bridge Rd., London, S. E. 26, England
COLE, LTD., E. K., Electronics Div., Malmesbury, Wiltshire, England. ADV. PG. 28
Cole Instrument Co., 1320 S. Grand Ave., Los Angeles 15, Calif.
Communication Measurement Lab., Inc., 350 Leland Ave., Plainfield, N. J.
Computer Corp. of America, 149 Church St., New York, N. Y.
Cosser (Canada) Ltd., 301 Windsor St., Halifax, N. S., Canada
Doelcam Corp., 56 Elmwood St., Newton, Mass.
Douglas Radio Labs., 176 Norfolk Ave., Boston 19, Mass.
Eclipse-Pioneer Div., Bendix Aviation Corp., Teterboro, N. J.
Electro Products Labs., Inc., 4501 N. Ravenswood, Chicago 6, Ill.
ELECTRONIC ASSOCIATES, INC., Long Branch, N. J. ADV. PG. 9
Electronic Measurements Co., Inc., Lewis St. & Maple Ave., Eatontown, N. J.
El-Tronics, Inc., 2649 N. Howard St., Philadelphia 33, Pa.
Fairchild Recording Equipment Corp., 154th St. & 7th Ave., Whitestone, N. Y.
Federal Telephone & Radio Corp., 100 Kingsland Rd., Clifton, N. J.
Fleming Radio Ltd., 18-20 Laystall St., London, E. C. 1, England
Fluke Engineering Co., John, 1111 W. Nickersen St., Seattle 99, Wash.
Ford Instrument Co., 31-10 Thomson Ave., Long Island City, N. Y.
FURST ELECTRONICS, 3322A W. Lawrence Ave., Chicago 25, Ill. ADV. PG. 110
Gaveco Labs., Inc., 2 East End Ave., New York 21, N. Y.
General Electric Co., Electronics Div., Electronics Park, Syracuse, N. Y.
Inet, Inc., 8655 S. Main St., Los Angeles 3, Calif.
International Rectifier Corp., 1521 E. Grand Ave., El Segundo, Calif.
Jowil Electronics Inc., 7945 Germantown Ave., Philadelphia 18, Pa.
KEPCO LABS., INC., 131-38 Sanford Ave., Flushing, N. Y. ADV. PGS. 10, 11
LAMBDA ELECTRONICS CORP., 103-02 Northern Blvd., Corona 68, N. Y. ADV. PG. 131
Langevin Mfg. Corp., 37 W. 65th St., New York 23, N. Y.
Macdonald Co., Inc., W. S., 33 University Rd., Cambridge 38, Mass.
MacLeod & Hanopol, Inc., 10 Roland St., Charlestown 29, Mass.
Mallory & Co., Inc., P. R., 3029 E. Washington St., Indianapolis 6, Ind.
Manson Laboratories, 207 Greenwich Ave., Stamford, Conn.
Measurement Engineering Ltd., Arnprior, Ontario, Canada
Mercury Electronic Co., Box 450, Red Bank, N. J.
Moulic Specialties Co., 1005 W. Washington St., Bloomington, Ill.

NUCLEAR AND ALLIED PRODUCTS

National Spectrographic Labs., Inc., 6300 Euclid Ave., Cleveland 3, Ohio
NEUTRONIC ASSOCIATES, 83–56 Vietor Ave., Elmhurst 73, N. Y. ADV. PG. 101
Nuclear Measurements Corp., 2460 N. Arlington Ave., Indianapolis 18, Ind.
NUCLEAR RESEARCH CORP., 2563 Grays Ferry Ave., Philadelphia 46, Pa. ADV. PG. 97
Nuclear Specialty Co., P. O. Box 455, Center Moriches, N. Y.
Oak Ridge Products Mfg. Div., Video Television, Inc., 37–01 Vernon Blvd., Long Island City 1, N. Y.
Opad-Green Co., 71 Warren St., New York, N. Y.
Oregon Electronic Mfg. Co., 2232 E. Burnside St., Portland 15, Ore.
Pacific Division, Bendix Aviation Corp., 11600 Sherman Way, North Hollywood, Calif.
Paschel Electronics, Inc., 13 Garden St., New Rochelle, N. Y.
Phoenix Precision Instrument Co., 3803–05 N. 5th St., Philadelphia, Pa.
Polarad Electronics Corp., 100 Metropolitan Ave., Brooklyn 11, N. Y.
Process & Instruments, 60 Greenpoint Ave., Brooklyn 22, N. Y.
Radiation Counter Labs., Inc., 1844 W. 21st St., Chicago 8, Ill.
RADIATION INSTRUMENT DEVELOPMENT LAB., 2337 W. 67th St., Chicago 36, Ill. ADV. PG. Inside Back Cover
Raytheon Mfg. Co., Equipment Sales Div., Waltham 54, Mass.
Red Bank Division, Bendix Aviation Corp., Eatontown, N. J.
Resdel Engineering, 2351 Riverside Drive, Los Angeles 39, Calif.
Rutherford Electronics Corp., 3707 S. Robertson Blvd., Culver City, Calif.
SANBORN CO., 39 Osborn St., Cambridge, Mass. ADV. PG. 92
SCIENTIFIC SPECIALTIES CORP., Snow & Union Sts., Brighton 35, Mass. ADV. PG. 122
Sherron Electronics Co., 1201 Flushing Ave., Brooklyn 6, N. Y.
Sierra Electronic Corp., San Carlos, Calif.
SORENSEN & CO., INC., 375 Fairfield Ave., Stamford, Conn. ADV. PG. 125
Southwestern Industrial Electronics Co., 2831 Post Oak Rd., P. O. Box 13058, Houston 19, Texas
Spellman Television Co., Inc., 3029 Webster Ave., Bronx 67, N. Y.
Sperry Gyroscope Co., Great Neck, N. Y.
Square Root Mfg. Corp., 391 Saw Mill River Rd., Yonkers, N. Y.
Standard Electronics Research Corp., 2 East End Ave., New York 21, N. Y.
T. L. G. Electric Corp., 31 W. 27th St., New York 1, N. Y.
Tech Laboratories, Inc., Bergen & Edsall Blvds., Palisades Park, N. J.
Telechrome, Inc., 88 Merrick Road, Amityville, N. Y.
Tel-Instrument Co., 50 Paterson Ave., East Rutherford, N. J.
Ther Electric & Machine Works, 15 S. Jefferson St., Chicago 6, Ill.
Varian Associates, 990 Varian St., San Carlos, Calif.
Varo Mfg. Co., Inc., Box 638, Garland, Texas
VICTOREEN INSTRUMENT CO., 3900 Perkins Ave., Cleveland 14, Ohio. ADV. PG. Inside Front Cover
Walkirt Co., 145 W. Hazel, Inglewood, Calif.
West Coast Electronics Co., 5873 W. Jefferson, Los Angeles 16, Calif.
Weston Laboratories, Weston 93, Mass.

PREAMPLIFIERS

Air Associates, Inc., Teterboro, N. J.
Airmec Laboratories, Ltd., High Wycombe, Buckinghamshire, England
Allied Radio Corp., 833 W. Jackson Blvd., Chicago 7, Ill.
American Electronic Laboratories, Inc., 641 Arch St., Philadelphia 6, Pa.
ATOMIC INSTRUMENT CO., 84 Massachusetts Ave., Cambridge 39, Mass. ADV. PG. 23
Atomlab, Inc., 489 Fifth Ave., New York 17, N. Y.
Audio Instrument Co., Inc., 133 W. 14th St., New York 11, N. Y.
Avion Instrument Corp., Paramus, N. J.
Beck Engineering Co., 37–41 Morcy St., Freehold, N. J.
Caltron Co., 1406 S. Hobart Blvd., Los Angeles 6, Calif.
Cinema Engineering Co., 1510 W. Verdugo Ave., Burbank, Calif.
COLE, LTD., E. K., Electronics Div., Malmesbury, Wiltshire, England. ADV. PG. 28
Cole Instrument Co., 1320 S. Grand Ave., Los Angeles 15, Calif.
Collins Radio Co., Cedar Rapids, Iowa
Cossor (Canada) Ltd., 301 Windsor St., Halifax, N. S., Canada
Douglas Radio Labs., 176 Norfolk Ave., Boston 19, Mass.
Electric & Musical Industries Ltd., Hayes, Middlesex, England
Electro-Mechanical Research Inc., 64 Main St., Ridgefield, Conn.
Electrodyne Co., 32 Oliver St., Boston, Mass.
Electronic Tube Corp., 1200 E. Mermaid Lane, Philadelphia 18, Pa.
El-Tronics, Inc., 2649 N. Howard St., Philadelphia 33, Pa.
Engineering Research Associates, Inc., 1902 W. Minnehaha Ave., St. Paul 4, Minn.
Fairchild Recording Equipment Corp., 154th St. & 7th Ave., Whitestone, N. Y.
Ferrand Optical Co., Inc., Bronx Blvd. at E. 238th St., New York 70, N. Y.
Fleming Radio Ltd., 18–20 Laystall St., London, E. C. 1, England
Ford Instrument Co., 31–10 Thomson Ave., Long Island City, N. Y.
FURST ELECTRONICS, 3322A W. Lawrence Ave., Chicago 25, Ill. ADV. PG. 110
Hartley Co., Ltd., H. A., 152 Hammersmith Rd., London W. 6, England
Industrial Control Co., Straight Path & Arlington Ave., Wyandanch, N. Y.
Industrial Science Associates, 542 Fifth Ave., New York 19, N. Y.
Jewil Electronics Inc., 7945 Germantown Ave., Philadelphia 18, Pa.
Keithley Instruments, 3868 Carnegie Ave., Cleveland, Ohio
Langevin Mfg. Corp., 37 W. 65th St., New York 23, N. Y.
McIntosh Engineering Lab., Inc., 320 Water St., Binghamton, N. Y.
MICHEL MFG. CO., 227 N. Water St., Milwaukee 2, Wis. ADV. PG. 134
Newcomb Audio Products Co., 6824 Lexington Ave., Hollywood 38, Calif.
Nuclear Measurements Corp., 2460 N. Arlington Ave., Indianapolis 18, Ind.
NUCLEAR RESEARCH & DEVELOPMENT INC., 1094 Sutter Ave., St. Louis, Mo. ADV. PG. 103
Nuclear Specialty Co., P. O. Box 455, Center Moriches, N. Y.
Patterson Moos & Co., Inc., 32–36 47th Ave., Long Island City 1, N. Y.
Plastics & Electronics Co., 272 Northland Ave., Buffalo 8, N. Y.
Process & Instruments, 60 Greenpoint Ave., Brooklyn 22, N. Y.
Radiation Counter Labs., Inc., 1844 W. 21st St., Chicago 8, Ill.
RADIATION INSTRUMENT DEVELOPMENT LAB., 2337 W. 67th St., Chicago 36, Ill. ADV. PG. Inside Back Cover
Resdel Engineering, 2351 Riverside Drive, Los Angeles 29, Calif.
SANBORN CO., 39 Osborn St., Cambridge, Mass. ADV. PG. 92
Servo Corp. of America, 2020 Jericho Turnpike, New Hyde Park, N. Y.
Sierra Electronic Corp., San Carlos, Calif.
Simpson Mfg. Co., Inc., Mark, 33–28 49th St., Long Island City 3, N. Y.
SPENCER-KENNEDY LABS., INC., 186 Massachusetts Ave., Cambridge 39, Mass. ADV. PG. 12
Square Root Mfg. Corp., 391 Saw Mill River Rd., Yonkers, N. Y.
Standard Electronics Research Corp., 2 East End Ave., New York 21, N. Y.
Tech Laboratories, Inc., Bergen & Edsall Blvds., Palisades Park, N. J.
Technology Instrument Corp., 531 Main St., Acton, Mass.
Tektronix, Inc., P. O. Box 831, Portland 7, Ore.
Telechrome, Inc., 88 Merrick Road, Amityville, N. Y.
Telectro Industries Corp., 35–18 37th St., Long Island City 1, N. Y.
TRACERLAB, INC., 130 High St., Boston 10, Mass. ADV. PG. 24
Thordarson-Meissner Mfg. Divs., Mt. Carmel, Ill.
Waveforms, Inc., 333 Sixth Ave., New York 14, N. Y.
Weston Laboratories, Weston 93, Mass.

PRESSES—Laboratory

American Steel Foundries, Elmes Engineering Division, 1150 Tennessee Ave., Cincinnati 29, Ohio
Denison Engineering Co., 1186 Dublin Rd., Columbus, Ohio
Fisher Scientific Co., 709 Forbes St., Pittsburgh 19, Pa.
Jarrell-Ash Co., 165 Newberry St., Boston 16, Mass.
Mica Instrument Co., 80 Trowbridge St., Cambridge 38, Mass.
Shriver & Co., Inc., 808 Hamilton St., Harrison, N. J.
STOKES MACHINE CO., F. J., Frankford Station P. O., Philadelphia 20, Pa. ADV. PG. 117
Yonkers Laboratory Supply Co., 70 Palisade Ave., Yonkers 2, N. Y.

PRESSES—Pelleting

Denison Engineering Co., 1186 Dublin Rd., Columbus, Ohio
Fisher Scientific Co., 709 Forbes St., Pittsburgh 19, Pa.
General Mixing Equipment Co., 413 N. 3rd St., Philadelphia, Pa.
Jarrell-Ash Co., 165 Newberry St., Boston 16, Mass.
Parr Instrument Co., Moline, Ill.

PROJECTORS—Slide

American Optical Co., Southbridge, Mass.
Bausch & Lomb Optical Co., 630 St. Paul St., Rochester 2, N. Y.
Gale Dorothea Mechanisms, Inc., 81–01 Broadway, Elmhurst, N. Y.
Jarrell-Ash Co., 165 Newberry St., Boston 16, Mass.
LEITZ, INC., E., 304 Hudson St. at Spring St., New York 13, N. Y. ADV. PG. 121

PSYCHROMETERS—Sling

Foxboro Co., 38 Neponset Ave., Foxboro, Mass.
Hill & Co., E. Vernon, 6829 W. Highland Ave., Chicago 31, Ill.
Johnson Service Co., 507 E. Michigan St., Milwaukee 2, Wis.
Kahl Scientific Instrument Corp., Box 1166, El Cajon, Calif.
Welch Scientific Co., W. M., 1515 Sedgwick St., Chicago 10, Ill.
WESTON ELECTRICAL INSTRUMENT CORP., 614 Frelinghuysen Ave., Newark 5, N. J. ADV. PG. 102
Yonkers Laboratory Supply Co., 70 Palisade Ave., Yonkers 2, N. Y.

PULVERIZERS

Babcock & Wilcox Co., 161 E. 42nd St., New York 17, N. Y.
Pulverizing Machinery Co., 43 Chatham Rd., Summit, N. J.

PUMPS—Centrifugal Vacuum

American Vacuum Co., 816 S. Michigan Ave., Chicago, Ill.
Beach-Russ Co., 44 Church St., New York 7, N. Y.
STOKES MACHINE CO., F. J., Frankford Station P. O., Philadelphia 20, Pa. ADV. PG. 117
Worthington Corp., 426 Worthington Ave., Harrison, N. J.

PUMPS—Metering

Hinckley Technical Associates, Inc., 75 Orchard St., Belmont 78, Mass.
Lapp Insulator Co., Inc., 31 Gilbert St., LeRoy, N. Y.
Robinson, Inc., Edward E., 93 Park Ave., Nutley 10, N. J.

PUMPS—Vacuum

Allis-Chalmers Mfg. Co., 935 S. 70th St., Milwaukee, Wis.
Alos Scientific Div. of A. S. Aloe Co., 5655 Kingsbury Blvd., St. Louis 12, Mo.
American Vacuum Co., 816 S. Michigan Ave., Chicago, Ill.
Beach-Russ Co., 44 Church St., New York 7, N. Y.
Central Scientific Co., 1700 Irving Park Rd., Chicago 13, Ill.
Dayflight Vacuum Products Co., 8207 N. Milwaukee Ave., Chicago 30, Ill.
DISTILLATION PRODUCTS INDUSTRIES, A Division of Eastman Kodak Co., Rochester 3, N. Y. ADV. PG. 91
Eberbach Corporation, Ann Arbor, Mich.
Eck & Krebs, Inc., 27–09 40th Ave., Long Island City 1, N. Y.
Eclipse-Pioneer Div., Bendix Aviation Corp., Teterboro, N. Y.
Eisler Engineering Co., 760 S. 13th St., Newark 3, N. J.
Eitel-McCullough, Inc., San Bruno, Calif.
Foster Pump Works, Inc., 80 Washington & Front Sts., Brooklyn 1, N. Y.
Fredericks Co., George E., Bethayres, Pa.
HIGH VOLTAGE ENGINEERING CORP., 7 University Rd., Cambridge 38, Mass. ADV. PG. 20
INTERNATIONAL PUMP & MACHINE WORKS, 11–13 Governor St., Newark 2, N. J. ADV. PG. 128
Joy Mfg. Co., Oliver Bldg., Pittsburgh 22, Pa.
Kahl Scientific Instrument Corp., Box 1166, El Cajon, Calif.
KINNEY MFG. Co., 3529 Washington St., Boston, Mass. ADV. PG. 95
NATIONAL RESEARCH CORP., 70 Memorial Drive, Cambridge 42, Mass. ADV. PG. 16
OPTICAL FILM ENGINEERING CO., 2731–37 N. 6th St., Philadelphia 33, Pa. ADV. PG. 106
Phillips-Drucker, 2245 S. Vandeventer Ave., St. Louis, Mo.
Phipps & Bird, Inc., 303 S. 6th St., Richmond 5, Va.
STOKES MACHINE CO., F. J., Frankford Station P. O., Philadelphia 20, Pa. ADV. PG. 117
Universal X-Ray Products, Inc., 1140 N. Western Ave., Chicago 22, Ill.
Welch Scientific Co., W. M., 1515 Sedgwick St., Chicago 10, Ill.

Whittington Pump & Engineering Corp., 1126 Prospect St., Indianapolis 3, Ind.
Worthington Corp., 426 Worthington Ave., Harrison, N. J.
Yonkers Laboratory Supply Co., 70 Palisade Ave., Yonkers 2, N. Y.

PYROMETERS

Assembly Products, Inc., Chagrin Falls 6, Ohio
Bristol Co., The, Waterbury 20, Conn.
CAMBRIDGE INSTRUMENT CO., INC., 3786 Grand Central Terminal, New York 17, N. Y. ADV. PG. 123
Cole Instrument Co., 1320 S. Grand Ave., Los Angeles 15, Calif.
Electric Hotpack Co., Inc., 5035 Cottman Ave., Philadelphia, Pa.
Ess Instrument Co., 98 S. Washington Ave., Bergenfield, N. J.
Foxboro Co., 38 Neponset Ave., Foxboro, Mass.
J B T Instruments Inc., 441 Chapel St., New Haven 8, Conn.
Leeds & Northrup Co., 4970 Stenton Ave., Philadelphia 44, Pa.
Minneapolis-Honeywell Regulator Co., 2753 Fourth Ave. S., Minneapolis, Minn.
Pyrometer Instrument Co., Inc., Bergenfield, N. J.
Richards Co., Inc., Arklay S., 12 Winchester St., Newton Highlands 61, Mass.
Roller-Smith Corp., 1000 Eighth Ave., Bethlehem, Pa.
Servo Corp. of America, 2020 Jericho Turnpike, New Hyde Park, N. Y.
Taco West Corp., 525 N. Noble St., Chicago 22, Ill.
Thermo Electric Mfg. Co., 465 Huff, Dubuque, Ia.
Thwing-Albert Instrument Co., Penn St. & Pulaski Ave., Philadelphia 44, Pa.
WESTON ELECTRICAL INSTRUMENT CORP., 614 Frelinghuysen Ave., Newark 5, N. J. ADV. PG. 102
Wheelco Instrument Co., 847 W. Harrison St., Chicago 7, Ill.
Winslow Co., Inc., 9 Liberty St., Newark, N. J.
Yonkers Laboratory Supply Co., 70 Palisade Ave., Yonkers 2, N. Y.

QUARTZ—Fused

Cooper-Hewitt Electric Co., 721 Grand St., Hoboken, N. J.
Daylight Vacuum Products Co., 5207 N. Milwaukee Ave., Chicago 30, Ill.
General Ceramics & Steatite Corp., 250 Crows Mill Rd., Keasbey, N. J.
Hanovia Chemical & Mfg. Co., 233 N. J. R. R. Ave., Newark 5, N. J.
Kahl Scientific Instrument Corp., Box 1166, El Cajon, Calif.
Phoenix Precision Instrument Co., 3803-05 N. 5th St., Philadelphia, Pa.

RADIOGRAPHIC EQUIPMENT—Gamma Ray

ATOMIC ENERGY OF CANADA, LTD., Commercial Products Div., P. O. Box 93, Ottawa, Ontario, Canada. ADV. PG. 18
BAR-RAY PRODUCTS, INC., 209 25th St., Brooklyn 32, N. Y. ADV. PG. 112
CAMBRIDGE INSTRUMENT CO., INC., 3786 Grand Central Terminal, New York 17, N. Y. ADV. PG. 123
CANADIAN RADIUM & URANIUM CORP., 630 Fifth Ave., New York 20, N. Y. ADV. PG. 116
Cinema Television Ltd., Worsley Bridge Rd., London S. E. 26, England
El-Tronics, Inc., 2649 N. Howard St., Philadelphia 33, Pa.
Falk & Co., Ltd., M., 5 Victoria St., London, S. W. 1, England
Isotope Products Ltd., Davis Rd., P. O. Box 127, Oakville, Ontario, Canada
ISOTOPE SPECIALTIES CO., 3816 San Fernando Rd., Glendale, Calif. ADV. PG. 94
NUCLEAR RESEARCH & DEVELOPMENT INC., 1094 Sutter Ave., St. Louis, Mo. ADV. PG. 103
Ohmart Corp., The, 2347 Ferguson Ave., Cincinnati 38, Ohio
Patterson, Moos & Co., Inc., 32-36 47th Ave., Long Island City 1, N. Y.
R-C SCIENTIFIC INSTRUMENT CO., 335 Culver Blvd., Playa Del Rey, Calif. ADV. PG. 129
Radium Chemical Co., 161 E. 42nd St., New York 17, N. Y.
St. John X-Ray Laboratory, Califon, N. J.
TECHNICAL ASSOCIATES, INC., 140 W. Providencia Ave., Burbank, Calif. ADV. PG. 130
TRACERLAB, INC., 130 High St., Boston 10, Mass. ADV. PG. 24
VICTOREEN INSTRUMENT CO., 3800 Perkins Ave., Cleveland 14, Ohio. ADV. PG. Inside Front Cover
Western Radiation Lab., 1107 W. 24th St., Los Angeles 27, Calif.

RADIOGRAPHIC EQUIPMENT—X-Ray

BAR-RAY PRODUCTS, INC., 209 25th St., Brooklyn 32, N. Y. ADV. PG. 112
Bracke-Seib X-Ray Co., Inc., 293 Third Ave., New York 10, N. Y.
CANADIAN RADIUM & URANIUM CORP., 630 Fifth Ave., New York 20, N. Y. ADV. PG. 116
Falk & Co., Ltd., M., 5 Victoria St., London, S. W. 1, England
HIGH VOLTAGE ENGINEERING CORP., 7 University Rd., Cambridge 38, Mass. ADV. PG. 20
Jarrell-Ash Co., 165 Newberry St., Boston 16, Mass.
Mullard Overseas Ltd., Century House, Shaftesbury Ave., London W. C. 2, England
Ohmart Corp., The, 2347 Ferguson Ave., Cincinnati 38, Ohio
Picker X-Ray Corp., 25 S. Broadway, White Plains, N. Y.
St. John X-Ray Laboratory, Califon, N. J.
Universal X-Ray Products, Inc., 1140 N. Western Ave., Chicago 22, Ill.
VICTOREEN INSTRUMENT CO., 3800 Perkins Ave., Cleveland 14, Ohio. ADV. PG. Inside Front Cover
X-Ray Department of General Electric Co., 4855 Electric Ave., Milwaukee 1, Wis.

REACTOR CONTROLS—Nuclear

See Controls—Nuclear Reactor

RECORDERS—Fluid Flow

Automatic Temperature Control Co., Inc., 5206 Pulaski Ave., Philadelphia 44, Pa.
Bristol Co., The, Waterbury 20, Conn.
Builders-Providence, Inc., P. O. Box 1342, Providence 1, R. I.
Fischer & Porter Co., 50 County Line Rd., Hatboro, Pa.
Foxboro Co., 38 Neponset Ave., Foxboro, Mass.
Gevaco Labs., Inc., 2 East End Ave., New York 21, N. Y.
Hays Corp., Michigan City, Ind.
Leeds & Northrup Co., 4970 Stenton Ave., Philadelphia 44, Pa.
Minneapolis-Honeywell Regulator Co., 2753 Fourth Ave. S., Minneapolis, Minn.
MINNEAPOLIS-HONEYWELL REGULATOR CO., Wayne & Roberts Aves., Philadelphia 44, Pa. ADV. PG. 29
Phoenix Precision Instrument Co., 3803-05 N. 5th St., Philadelphia, Pa.
Precision Scientific Co., 3737 W. Cortland St., Chicago 47, Ill.
Swartwout Co., 18547 Euclid Ave., Cleveland, Ohio
Taylor Instrument Companies, 95 Ames St., Rochester, N. Y.
U. S. Gauge Div., American Machine & Metals, Inc., Sellersville, Pa.

RECORDERS—Graphic

Alfax Paper & Engineering Co., P. O. Box 125, Westboro, Mass.
Automatic Temperature Control Co., Inc., 5206 Pulaski Ave., Philadelphia 44, Pa.
Barnes Development Co., 213 W. Baltimore Pike, Lansdowne, Pa.
Berndt-Bach, Inc., 7377 Beverly Blvd., Los Angeles 36, Calif.
Bristol Co., The, Waterbury 20, Conn.
Consolidated Engineering Corp., 300 N. Sierra Madre Villa, Pasadena 8, Calif.
Edin Co., Inc., 207 Main St., Worcester, Mass.
Electrodyne Co., 32 Oliver St., Boston, Mass.
Esterline-Angus Co., Inc., P. O. Box 596, Indianapolis 6, Ind.
Fielden Instrument Division, Robertshaw-Fulton Controls Co., 2920 N. 4th St., Philadelphia 33, Pa.
Ford Instrument Co., 31-10 Thomson Ave., Long Island City, N. Y.
Foxboro Co., 38 Neponset Ave., Foxboro, Mass.
Gorrell & Gorrell, Haworth, N. J.
Hogan Laboratories, Inc., 155 Perry St., New York 14, N. Y.
Leeds & Northrup Co., 4970 Stenton Ave., Philadelphia 44, Pa.
Librascope, Inc., 1607 Flower St., Glendale 1, Calif.
Raytheon Mfg. Co., Equipment Sales Div., Waltham 54, Mass.
SANBORN CO., 39 Osborn St., Cambridge, Mass. ADV. PG. 92
Servo Corp. of America, 2020 Jericho Turnpike, New Hyde Park, N. Y.
SERVOMECHANISMS, INC., Post & Stewart Aves., Westbury, N. Y. ADV. PG. 109
Sound Apparatus Co., Stirling, N. J.
Stickl, Inc., Herman H., 27 Park Place, New York 7, N. Y.
Swartwout Co., 18547 Euclid Ave., Cleveland, Ohio

RECORDERS—Humidity & Temperature

Automatic Temperature Control Co., Inc., 5206 Pulaski Ave., Philadelphia 44, Pa.
CAMBRIDGE INSTRUMENT CO., INC., 3786 Grand Central Terminal, New York 17, N. Y. ADV. PG. 123
Daylight Vacuum Products Co., 5207 N. Milwaukee Ave., Chicago 30, Ill.
Electric Auto-Lite Co., Instrument & Gauge Div., Toledo 1, Ohio
Fielden Instrument Division, Robertshaw-Fulton Controls Co., 2920 N. 4th St., Philadelphia 33, Pa.
Foxboro Co., 38 Neponset Ave., Foxboro, Mass.
General Biochemicals Inc., Laboratory Park, Chagrin Falls, Ohio
Hill & Co., E. Vernon, 6829 W. Highland Ave., Chicago 31, Ill.
Johnson Service Co., 507 E. Michigan St., Milwaukee 2, Wis.
Leeds & Northrup Co., 4970 Stenton Ave., Philadelphia 44, Pa.
Manning, Maxwell & Moore, Inc., Stratford, Conn.
Minneapolis-Honeywell Regulator Co., 2753 Fourth Ave. S., Minneapolis, Minn.
MINNEAPOLIS-HONEYWELL REGULATOR CO., Wayne & Roberts Aves., Philadelphia 44, Pa. ADV. PG. 29
Moeller Instrument Co., 132nd St. & 89th Ave., Richmond Hill 18, N. Y.
Partlow Corp., The, 2 Campion Rd., New Hartford, N. Y.
Powers Regulator Co., 3400 Oakton, Skokie, Ill.
Serdex, Inc., 91 Cambridge St., Boston, Mass.
Streeter-Amet Co., 4101 Ravenswood Ave., Chicago 13, Ill.
Swartwout Co., 18547 Euclid Ave., Cleveland, Ohio
Taylor Instrument Companies, 95 Ames St., Rochester, N. Y.
Thwing-Albert Instrument Co., Penn St., & Pulaski Ave., Philadelphia 44, Pa.
U. S. Gauge Div., American Machine & Metals, Inc., Sellersville, Pa.
Weksler Thermometer Corp., Martinique Bldg., 49 W. 32nd St., New York 1, N. Y.
WESTON ELECTRICAL INSTRUMENT CORP., 614 Frelinghuysen Ave., Newark 5, N. J. ADV. PG. 102
Wheelco Instrument Co., 847 W. Harrison St., Chicago 7, Ill.

RECORDERS—Line

ATOMIC INSTRUMENT CO., 84 Massachusetts Ave., Cambridge 39, Mass. ADV. PG. 23
Automatic Temperature Control Co., Inc., 5206 Pulaski Ave., Philadelphia 44, Pa.
Esterline-Angus Co., Inc., P. O. Box 596, Indianapolis 6, Ind.
Fielden Instrument Division, Robertshaw-Fulton Controls Co., 2920 N. 4th St., Philadelphia 33, Pa.
Gorrell & Gorrell, Haworth, N. J.
Leeds & Northrup Co., 4970 Stenton Ave., Philadelphia 44, Pa.
Telectro Industries Corp., 35-18 37th St., Long Island City 1, N. Y.

RECORDERS—Liquid Level

Automatic Temperature Control Co., Inc., 5206 Pulaski Ave., Philadelphia 44, Pa.
Bogue Electric Mfg. Co., 52 Iowa Ave., Paterson 3, N. J.
Bristol Co., The, Waterbury 20, Conn.
Builders-Providence, Inc., P. O. Box 1342, Providence 1, R. I.
Fielden Instrument Division, Robertshaw-Fulton Controls Co., 2920 N. 4th St., Philadelphia 33, Pa.
Fischer & Porter Co., 50 County Line Rd., Hatboro, Pa.
Foxboro Co., 38 Neponset Ave., Foxboro, Mass.
Hays Corp., Michigan City, Ind.
Leeds & Northrup Co., 4970 Stenton Ave., Philadelphia 44, Pa.
Manning, Maxwell & Moore, Inc., Stratford, Conn.
Minneapolis-Honeywell Regulator Co., 2753 Fourth Ave. S., Minneapolis, Minn.
MINNEAPOLIS-HONEYWELL REGULATOR CO., Wayne & Roberts Aves., Philadelphia 44, Pa. ADV. PG. 29
Ohmart Corp., The, 2347 Ferguson Ave., Cincinnati 38, Ohio
Streeter-Amet Co., 4101 Ravenswood Ave., Chicago 13, Ill.
Swartwout Co., 18547 Euclid Ave., Cleveland, Ohio
Taylor Instrument Companies, 95 Ames St., Rochester, N. Y.

RECORDERS—Milliammeter

Bristol Co., The, Waterbury 20, Conn.
Esterline-Angus Co., Inc., P. O. Box 596, Indianapolis 6, Ind.
Fielden Instrument Division, Robertshaw-Fulton Controls Co., 2920 N. 4th St., Philadelphia 33, Pa.
Foxboro Co., 38 Neponset Ave., Foxboro, Mass.
GENERAL ELECTRIC CO., Apparatus Sales Div., Schenectady 5, N. Y. ADV. PGS. 2-3
Leeds & Northrup Co., 4970 Stenton Ave., Philadelphia 44, Pa.
Manning, Maxwell & Moore, Inc., Stratford, Conn.
NUCLEAR INSTRUMENT & CHEMICAL CORP., 223 W. Erie St., Chicago 10, Ill. ADV. PG. Back Cover

Streator-Amet Co., 4101 Ravenswood Ave., Chicago 13, Ill.
Wallace & Tiernan Products, Inc., Belleville 9, N. J.
Westinghouse Electric Corp., P. O. Box 868, Pittsburgh 30, Pa.
WESTON ELECTRICAL INSTRUMENT CORP., 614 Frelinghuysen Ave., Newark 5, N. J. ADV. PG. 102

RECORDERS—Nuclear Radiation

ANTON ELECTRONIC LABS., INC., 1226-38 Flushing Ave., Brooklyn 37, N. Y. ADV. PG. 136
ATOMIC INSTRUMENT CO., 84 Massachusetts Ave., Cambridge 39, Mass. ADV. PG. 23
Atomlab, Inc., 489 Fifth Ave., New York 17, N. Y.
Cinema-Television Ltd., Worsley Bridge Rd., London, S. E. 26, England
Douglas Radio Labs., 176 Norfolk Ave., Boston 19, Mass.
El-Tronics, Inc., 2649 N. Howard St., Philadelphia 33, Pa.
GENERAL ELECTRIC CO., Apparatus Sales Div., Schenectady 5, N. Y. ADV. PGS. 2-5
Leeds & Northrup Co., 4970 Stenton Ave., Philadelphia 44, Pa.
North American Philips Co., Inc., 100 E. 42nd St., New York 17, N. Y.
NUCLEAR INSTRUMENT & CHEMICAL CORP., 223 W. Erie St., Chicago 10, Ill. ADV. PG. Back Cover
Nuclear Measurements Corp., 2460 N. Arlington Ave., Indianapolis 18, Ind.
NUCLEAR RESEARCH & DEVELOPMENT INC., 1094 Sutter Ave., St. Louis, Mo. ADV. PG. 103
Ohmart Corp., The, 2347 Ferguson Ave., Cincinnati 38, Ohio
R-C SCIENTIFIC INSTRUMENT CO., 335 Culver Blvd., Playa Del Rey, Calif. ADV. PG. 129
Radiation Counter Labs., Inc., 1844 W. 21st St., Chicago 8, Ill.
RADIATION INSTRUMENT DEVELOPMENT LAB., 2337 W. 67th St., Chicago 36, Ill. ADV. PG. Inside Back Cover
RADIOACTIVE PRODUCTS, INC., 443 W. Congress St., Detroit 26, Mich. ADV. PG. 8
Reedal Engineering, 2351 Riverside Drive, Los Angeles 39, Calif.
Streator-Amet Co., 4101 Ravenswood Ave., Chicago 13, Ill.
TECHNICAL ASSOCIATES, INC., 140 W. Providencia Ave., Burbank, Calif. ADV. PG. 130
TRACERLAB, INC., 130 High St., Boston 10, Mass. ADV. PG. 24
VICTOREEN INSTRUMENT CO., 3800 Perkins Ave., Cleveland 14, Ohio. ADV. PG. Inside Front Cover

RECORDERS—Potentiometer

Bristol Co., The, Waterbury 20, Conn.
ELECTRONIC ASSOCIATES, INC., Long Branch, N. J. ADV. PG. 9
Fielden Instrument Division, Robertshaw-Fulton Controls Co., 2920 N. 4th St., Philadelphia 33, Pa.
Ford Instrument Co., 31-10 Thomson Ave., Long Island City, N. Y.
Foxboro Co., 38 Neponset Ave., Foxboro, Mass.
Leeds & Northrup Co., 4970 Stenton Ave., Philadelphia 44, Pa.
Minneapolis-Honeywell Regulator Co., 2753 Fourth Ave. S., Minneapolis, Minn.
MINNEAPOLIS-HONEYWELL REGULATOR CO., Wayne & Roberts Aves., Philadelphia 44, Pa. ADV. PG. 29
Photocon Research Products, 421 N. Foothill Blvd., Pasadena 7, Calif.
Streator-Amet Co., 4101 Ravenswood Ave., Chicago 13, Ill.
Thwing-Albert Instrument Co., Penn St. & Pulaski Ave., Philadelphia 44, Pa.
WESTON ELECTRICAL INSTRUMENT CORP., 614 Frelinghuysen Ave., Newark 5, N. J. ADV. PG. 102
Wheelco Instrument Co., 847 W. Harrison St., Chicago 7, Ill.

RECORDERS—Telemetering

Air Associates, Inc., Teterboro, N. J.
Analex Corp., Concord, N. H.
Applied Science Corp. of Princeton, P. O. Box 44, Princeton, N. J.
ATOMIC INSTRUMENT CO., 84 Massachusetts Ave., Cambridge 39, Mass. ADV. PG. 23
Atomlab, Inc., 489 Fifth Ave., New York 17, N. Y.
Audio Instrument Co., 133 W. 14th St., New York 11, N. Y.
Avion Instrument Corp., Paramus, N. J.
Builders-Providence, Inc., P. O. Box 1342, Providence 1, R. I.
Cinema-Television Ltd., Worsley Bridge Rd., London, S. E. 26, England
Electrodyne Co., 32 Oliver St., Boston, Mass.
El-Tronics, Inc., 2649 N. Howard St., Philadelphia 33, Pa.
Fairchild Recording Equipment Corp., 154th St. & 7th Ave., Whitestone, N. Y.
Fielden Instrument Division, Robertshaw-Fulton Controls Co., 2920 N. 4th St., Philadelphia 33, Pa.
Ford Instrument Co., 31-10 Thomson Ave., Long Island City, N. Y.
Gulton Mfg. Corp., 212 Durham Ave., Metuchen, N. J.
Hays Corp., Michigan City, Ind.
Interelectronics Corp., 2432 Grand Concourse, New York 58, N. Y.
Leeds & Northrup Co., 4970 Stenton Ave., Philadelphia 44, Pa.
Manning, Maxwell & Moore, Inc., Stratford, Conn.
Melpar Inc., 452 Swann Ave., Alexandria, Va.
MINNEAPOLIS-HONEYWELL REGULATOR CO., Wayne & Roberts Aves., Philadelphia 44, Pa. ADV. PG. 29
NEUTRONIC ASSOCIATES, 83-56 Vieter Ave., Elmhurst 73, N. Y. ADV. PG. 101
Pacific Division, Bendix Aviation Corp., 11600 Sherman Way, North Hollywood, Calif.
R-C SCIENTIFIC INSTRUMENT CO., 335 Culver Blvd., Playa Del Rey, Calif. ADV. PG. 129
Streator-Amet Co., 4101 Ravenswood Ave., Chicago 13, Ill.
T. L. G. Electric Corp., 31 W. 27th St., New York 1, N. Y.
Telectro Industries Corp., 35-18 37th St., Long Island City 1, N. Y.
Westinghouse Electric Corp., P. O. Box 868, Pittsburgh 30, Pa.

RECTIFIERS—Electronic

Allied Radio Corp., 833 W. Jackson Blvd., Chicago 7, Ill.
Allis-Chalmers Mfg. Co., 935 S. 70th St., Milwaukee 1, Wis.
American Communications Corp., 306 Broadway, New York 7, N. Y.
Bogue Electric Mfg. Co., 52 Iowa Ave., Paterson 3, N. J.
Bogue Railway Equipment Div. of Bogue Electric Mfg. Co., 52 Iowa Ave., Paterson 3, N. J.
Chatham Electronics Corp., 475 Washington St., Newark 2, N. J.
Cinema Television Ltd., Worsley Bridge Rd., London, S. E. 26, England
Electric & Musical Industries, Ltd., Hayes, Middlesex, England
Electro Products Labs., Inc., 4501 N. Ravenswood, Chicago 6, Ill.
Electronic Control Corp., 1573 E. Forest St., Detroit 7, Mich.
Electronic Measurements Co., Inc., Lewis St. & Maple Ave., Eatontown, N. J.
FURST ELECTRONICS, 3322A W. Lawrence Ave., Chicago 25, Ill. ADV. PG. 110
Highland Engineering Co., Main St. & Urban Ave., Westbury, N. Y.
Industrial Science Associates, 542 Fifth Ave., New York 19, N. Y.
Inet, Inc., 8655 S. Main St., Los Angeles 3, Calif.
KEPCO LABS., INC., 131-38 Sanford Ave., Flushing, N. Y. ADV. PGS. 10, 11
Mellaphone Corp., Rochester 2, N. Y.
Mercury Electronic Co., Box 450, Red Bank, N. J.
Mullard Overseas Ltd., Century House, Shaftesbury Ave., London W. C. 2, England
Picker X-Ray Corp., 25 S. Broadway, White Plains, N. Y.
Raytheon Mfg. Co., Equipment Sales Div., Waltham 54, Mass.
Stephens Mfg. Corp., 8538 Warner Drive, Culver City, Calif.
SORENSEN & CO., INC., 375 Fairfield Ave., Stamford, Conn. ADV. PG. 125
Square Root Mfg. Corp., 391 Saw Mill River Rd., Yonkers, N. Y.
Sylvania Electric Products, Inc., 1740 Broadway, New York 19, N. Y.
T. L. G. Electric Corp., 31 W. 27th St., New York 1, N. Y.
Thor Electric & Machine Works, 15 S. Jefferson St., Chicago 6, Ill.
Varo Mfg. Co., Inc., Box 638, Garland, Texas
Weltronic Co., 19500 W. Eight Mile Rd., Detroit 19, Mich.
Western Sound & Electric Labs., Inc., 805 S. Fifth St., Milwaukee 4, Wis.
Weston Laboratories, Weston 93, Mass.

RECTIFIERS—Metallic

Allied Radio Corp., 833 W. Jackson Blvd., Chicago 7, Ill.
American Communications Corp., 306 Broadway, New York 7, N. Y.
Berkshire Laboratories, 588 Beaver Pond Rd., Lincoln, Mass.
Bogue Electric Mfg. Co., 52 Iowa Ave., Paterson 3, N. J.
Bogue Railway Equipment Div. of Bogue Electric Mfg. Co., 52 Iowa Ave., Paterson 3, N. J.
Bradley Labs., Inc., 168 Columbus Ave., New Haven 10, Conn.
Electro Products Labs., Inc., 4501 N. Ravenswood, Chicago 6, Ill.
Federal Telephone & Radio Corp., 100 Kingsland Rd., Clifton, N. J.
General Electric Co., Electronics Div., Electronics Park, Syracuse, N. Y.
Inet, Inc., 8655 S. Main St., Los Angeles 3, Calif.
International Rectifier Corp., 1521 E. Grand Ave., El Segundo, Calif.
Linick Chemical Co., 59 E. Madison St., Chicago 3, Ill.
Mallory & Co., Inc., P. R., 3029 E. Washington St., Indianapolis 6, Ind.
Mellaphone Corp., Rochester 2, N. Y.
Model Rectifier Corp., 557 Rogers Ave., Brooklyn 25, N. Y.
Opad-Green Co., 71 Warren St., New York 7, N. Y.
Polytechnic Research & Development Co., 55 Johnson St., Brooklyn 1, N. Y.
Sarkes Tarzian, Inc., Rectifier Div., 415 N. College Ave., Bloomington, Ind.
Square Root Mfg. Corp., 391 Saw Mill River Rd., Yonkers, N. Y.
Syntron Corp., 355 Lexington, Homer City, Pa.
Thor Electric & Machine Works, 15 S. Jefferson St., Chicago 6, Ill.
United Chromium, Inc., 100 E. 42nd St., New York, N. Y.
Vickers Electric Division, Vickers, Inc., 1815 Locust St., St. Louis, Mo.
Westinghouse Electric Corp., P. O. Box 868, Pittsburgh 30, Pa.

REFERENCE SOURCES & STANDARDS Radioactive

ATOMIC ENERGY OF CANADA, LTD., Commercial Products Div., P. O. Box 93, Ottawa, Ontario, Canada. ADV. PG. 18
ATOMIC INSTRUMENT CO., 84 Massachusetts Ave., Cambridge 39, Mass. ADV. PG. 23
Atomlab, Inc., 489 Fifth Ave., New York 17, N. Y.
El-Tronics, Inc., 2649 N. Howard St., Philadelphia 33, Pa.
Finkle, Raymond D., 2633 Santa Monica Blvd., Santa Monica, Calif.
ISOTOPE SPECIALTIES CO., 3816 San Fernando Rd., Glendale, Calif. ADV. PG. 94
R-C SCIENTIFIC INSTRUMENT CO., 335 Culver Blvd., Playa Del Rey, Calif. ADV. PG. 129
Radium Chemical Co., 161 E. 42nd St., New York 17, N. Y.
TECHNICAL OPERATIONS, INC., 6 Schouler Court, Arlington 74, Mass. ADV. PG. 128
TRACERLAB, INC., 130 High St., Boston 10, Mass. ADV. PG. 24
Twentieth Century Electronics, Ltd., Dunbar Works, Dunbar St., West Norwood, London, S. E. 27, England
U. S. Radium Corp., 535 Pearl St., New York 7, N. Y.

REFRACTOMETERS

American Optical Co., Instrument Div., Buffalo 15, N. Y.
Bausch & Lomb Optical Co., 630 St. Paul St., Rochester 2, N. Y.
Fisher Scientific Co., 709 Forbes St., Pittsburgh 19, Pa.
Gaertner Scientific Corp., 1237 Wrightwood Ave., Chicago, Ill.
Jarrell-Ash Co., 165 Newberry St., Boston 16, Mass.
Phoenix Precision Instrument Co., 3803-05 North 5th St., Philadelphia, Pa.
Precision Scientific Co., 3737 W. Cortland St., Chicago 47, Ill.

REFRIGERATION EQUIPMENT

Alco Valve Co., 865 Kingsland Ave., St. Louis 5, Mo.
BAR-RAY PRODUCTS, INC., 209 25th St., Brooklyn 32, N. Y. ADV. PG. 112
Bowser Technical Refrigeration Div., Bowser, Inc., Terryville, Conn.
Carrier Corp., 300 S. Geddes St., Syracuse 1, N. Y.
Cutler-Hammer Inc., 412 N. 12th St. Milwaukee 1, Wis.
General Electric Co., Air Conditioning Div., 5 Lawrence St., Bloomfield, N. J.
Harris, Inc., Machine Works, 61 S. E. Yamhill, Portland, Ore.
Minneapolis-Honeywell Regulator Co., 2753 Fourth Ave. S., Minneapolis, Minn.
SCIENTIFIC SPECIALTIES CORP., Snow & Union Sts., Brighton 35, Mass. ADV. PG. 122
Sherer-Gillett Co., Marshall, Mich.
Teaney Engineering, Inc., 26 Avenue B, Newark 5, N. J.
Trane Co., La Crosse, Wis.
United States Air Conditioning Corp., Como Ave. SE, at 33rd, Minneapolis 14, Minn.
Westinghouse Electric Corp., P. O. Box 868, Pittsburgh 30, Pa.
Worthington Corp., 426 Worthington Ave., Harrison, N. J.
York Corp., York, Pa.

REGISTERS

ATOMIC INSTRUMENT CO., 84 Massachusetts Ave., Cambridge 39, Mass. ADV. PG. 23
Cyclotron Specialties Co., Moraga 8, Calif.
Emerson-Sack-Warner Corp., 150 Dorchester Ave., South Boston 23, Mass.
Minneapolis-Honeywell Regulator Co., 2753 Fourth Ave. S., Minneapolis, Minn.
North American Philips Co., Inc., 100 E. 42nd St., New York 17, N. Y.
Production Instrument Co., 710 W. Jackson Blvd., Chicago 6, Ill.
Streeter-Amet Co., 4101 Ravenswood Ave., Chicago 13, Ill.

REGULATORS—Voltage

Acme Electric Corp., 31 Water St., Cuba, N. Y.
Acme Electronics, Inc., 300 N. Lake Ave., Pasadena 4, Calif.
Air Associates, Inc., Teterboro, N. J.
Allied Radio Corp., 833 W. Jackson Blvd., Chicago 7, Ill.
Allis-Chalmers Mfg. Co., 935 S. 70th St., Milwaukee 1, Wis.
American Relay & Controls, Inc., 4901 Flournoy St., Chicago 44, Ill.
ANTON ELECTRONIC LABS., INC., 1226-38 Flushing Ave., Brooklyn 37, N. Y. ADV. PG. 136
Avion Instrument Corp., Paramus, N. J.
Bogue Electric Mfg. Co., 52 Iowa Ave., Paterson 3, N. J.
Chatham Electronics Corp., 475 Washington St., Newark 2, N. J.
Clark Controller Co., 1146 E. 152nd St., Cleveland 10, Ohio
Clarostat Mfg. Co., Inc., Dover, New Hampshire
Eclipse-Pioneer Div., Bendix Aviation Corp., Teterboro, N. J.
Electronic Measurements Co., Inc., Lewis St. & Maple Ave., Eatontown, N. J.
Ford Instrument Co., 31-10 Thomson Ave., Long Island City, N. Y.
FURST ELECTRONICS, 3322A W. Lawrence Ave., Chicago 25, Ill. ADV. PG. 110
General Radio Co., 275 Massachusetts Ave., Cambridge 39, Mass.
Inet, Inc., 8655 S. Main St., Los Angeles 3, Calif.
KEPCO LABS., INC., 131-38 Sanford Ave., Flushing, N. Y. ADV. PGS. 10, 11
Magnetic Amplifiers, Inc., 632 Tinton Ave., New York 55, N. Y.
Mercury Electronic Co., Box 450, Red Bank, N. J.
Ohmite Mfg. Co., 4835 W. Flournoy St., Chicago 44, Ill.
Peschel Electronics, Inc., 13 Garden St., New Rochelle, N. Y.
Phipps & Bird, Inc., 303 S. 6th St., Richmond 5, Va.
Phoenix Precision Instrument Co., 3803-05 N. 5th St., Philadelphia, Pa.
Raytheon Mfg. Co., Equipment Sales Div., Waltham 54, Mass.
Red Bank Division, Bendix Aviation Corp., Eatontown, N. J.
Rutherford Electronics Corp., 3707 S. Robertson Blvd., Culver City, Calif.
Sola Electric Co., 4633 W. 16th St., Chicago 50, Ill.
SORENSEN & CO., INC., 375 Fairfield Ave., Stamford, Conn. ADV. PG. 125
Square Root Mfg. Corp., 391 Saw Mill River Rd., Yonkers, N. Y.
Superior Electric Co., The, 83 Laurel St., Bristol, Conn.
Transformers Specialty Co., Bala-Cynwyd, Pa.
Vara Mfg. Co., Inc., Box 638, Garland, Texas
Vickers Electric Division, Vickers, Inc., 1815 Locust St., St. Louis, Mo.
VICTOREEN INSTRUMENT CO., 3800 Perkins Ave., Cleveland 14, Ohio. ADV. PG. Inside Front Cover
Weltronic Co., 19500 W. Eight Mile Rd., Detroit 19, Mich.
Westinghouse Electric Corp., P. O. Box 868, Pittsburgh 30, Pa.
WESTON ELECTRICAL INSTRUMENT CORP., 614 Frelinghuysen Ave., Newark 5, N. J. ADV. PG. 102

RELAYS—Electric

Allied Radio Corp., 833 W. Jackson Blvd., Chicago 7, Ill.
American Relay & Controls, Inc., 4901 Flournoy St., Chicago 44, Ill.
Assembly Products, Inc., Chagrin Falls 6, Ohio
Automatic Temperature Control Co., Inc., 5206 Pulaski Ave., Philadelphia 44, Pa.
Clark Controller Co., 1146 E. 152nd St., Cleveland 10, Ohio
Cole Instrument Co., 1320 S. Grand Ave., Los Angeles 15, Calif.
Cutler-Hammer Inc., 412 N. 12th St., Milwaukee 1, Wis.
Federal Telephone & Radio Corp., 100 Kingsland Rd., Clifton, N. J.
GENERAL ELECTRIC CO., Apparatus Sales Div., Schenectady 5, N. Y. ADV. PGS. 2-5
Guardian Electric Co., 1625 W. Walnut St., Chicago 12, Ill.
Kellogg Switchboard & Supply Co., 79 W. Monroe, Chicago 3, Ill.
Lumenite Electric Co., 407 S. Dearborn St., Chicago 5, Ill.
Mercoid Corp., 4201 Belmont Ave., Chicago 41, Ill.
Minneapolis-Honeywell Regulator Co., 2753 Fourth Ave. S., Minneapolis, Minn.
MINNEAPOLIS-HONEYWELL REGULATOR CO., Wayne & Roberts Aves., Philadelphia 44, Pa. ADV. PG. 29
Phaostron Co., 151 Pasadena Ave., South Pasadena, Calif.
Precision Scientific Co., 3737 W. Cortland St., Chicago 47, Ill.
Price Electric Corp., Frederick, Md.
Red Bank Division, Bendix Aviation Corp., Eatontown, N. J.
Sargent & Co., E. H., 4647 W. Foster Ave., Chicago 30, Ill.
Square Root Mfg. Corp., 391 Saw Mill River Rd., Yonkers, N. Y.
Struthers-Dunn, Inc., 150 N. 13th St., Philadelphia 13, Pa.
Sun Electric Corp., 6323 Avondale Ave., Chicago 31, Ill.
Thermo Instrument Co., 1265 Old County Rd., Belmont, Calif.
Vara Mfg. Co., Inc., Box 638, Garland, Texas
Ward Leonard Electric Co., 21 South St., Mt. Vernon, N. Y.
WESTON ELECTRICAL INSTRUMENT CORP., 614 Frelinghuysen Ave., Newark 5, N. J. ADV. PG. 102

RELAYS—Sensitive

Allied Radio Corp., 833 W. Jackson Blvd., Chicago 7, Ill.
American Instrument Co., Inc., 8030 Georgia Ave., Silver Spring, Md.
American Relay & Controls, Inc., 4901 Flournoy St., Chicago 44, Ill.
Arrow-Hart & Hegeman Electric Co., 103 Hawthorne St., Hartford, Conn.
Automatic Temperature Control Co., Inc., 5206 Pulaski Ave., Philadelphia 44, Pa.
Biddle Co., James G., 1316 Arch St., Philadelphia 7, Pa.
Central Scientific Co., 1700 Irving Park Rd., Chicago 13, Ill.
Chandler & Stedman, 398 Newton St., Waltham 54, Mass.
Cole Instrument Co., 1320 S. Grand Ave., Los Angeles 15, Calif.
Cutler-Hammer Inc., 412 N. 12th St., Milwaukee 1, Wis.
Edison Inc., Thomas A., Instrument Div., West Orange, N. J.
Electric Design & Mfg. Corp., Burlington, Iowa
Electronic Control Corp., 1573 E. Forest St., Detroit 7, Mich.
Guardian Electric Co., 1625 W. Walnut St., Chicago 12, Ill.
Lumenite Electric Co., 407 S. Dearborn St., Chicago 5, Ill.
Manning, Maxwell & Moore, Inc., Stratford, Conn.
Minneapolis-Honeywell Regulator Co., 2753 Fourth Ave. S., Minneapolis, Minn.
Photobell Co., 116 Nassau St., New York 7, N. Y.
Precision Scientific Co., 3737 W. Cortland St., Chicago 47, Ill.
Price Electric Corp., Frederick, Md.
Sargent & Co., E. H., 4647 W. Foster Ave., Chicago 30, Ill.
Sola Electric Co., 4633 W. 16th St., Chicago 50, Ill.
Square Root Mfg. Corp., 391 Saw Mill River Rd., Yonkers, N. Y.
Struthers-Dunn, Inc., 150 N. 13th St., Philadelphia 13, Pa.
Ward Leonard Electric Co., 21 South St., Mt. Vernon, N. Y.
Westinghouse Electric Corp., P. O. Box 868, Pittsburgh 30, Pa.
WESTON ELECTRICAL INSTRUMENT CORP., 614 Frelinghuysen Ave., Newark 5, N. J. ADV. PG. 102

RELAYS—Thermal Delay

Allied Radio Corp., 833 W. Jackson Blvd., Chicago 7, Ill.
Automatic Temperature Control Co., Inc., 5206 Pulaski Ave., Philadelphia 44, Pa.
Cutler-Hammer Inc., 412 N. 12th St., Milwaukee 1, Wis.
Edison, Inc., Thomas A., Instrument Div., West Orange, N. J.
Kahl Scientific Instrument Corp., Box 1166, El Cajon, Calif.
Photobell Co., 116 Nassau St., New York 7, N. Y.
Roller-Smith Corp., 1000 Eighth Ave., Bethlehem, Pa.
Square Root Mfg. Corp., 391 Saw Mill River Rd., Yonkers, N. Y.
Struthers-Dunn, Inc., 150 N. 13th St., Philadelphia 7, Pa.
VICTOREEN INSTRUMENT CO., 3800 Perkins Ave., Cleveland 14, Ohio. ADV. PG. Inside Front Cover

REMOTE HANDLING DEVICES

AERONAUTICAL RESEARCH LABS., GENERAL MILLS, INC., 2010 E. Hennepin Ave., Minneapolis 13, Minn. ADV. PG. 99
Air Associates, Inc., Teterboro, N. J.
ATOMIC ENERGY OF CANADA, LTD., Commercial Products Div., P. O. Box 93, Ottawa, Ontario, Canada. ADV. PG. 18
Atomlab, Inc., 489 Fifth Ave., New York 17, N. Y.
Austin Co., Special Devices Div., 76 Ninth Ave., New York 11, N. Y.
CENTRAL RESEARCH LABORATORIES, INC., Red Wing, Minn. ADV. PG. 118
Collins Radio Co., Cedar Rapids, Iowa
Conoflow Corp., 2100 Arch St., Philadelphia 3, Pa.
Elm Laboratories, 18 South Broadway, Dobbs Ferry, N. Y.
El-Tronics, Inc., 2649 N. Howard St., Philadelphia 33, Pa.
Falk & Co., Ltd., M., 5 Victoria St., London, S. W. 1, England
Ford Instrument Co., 31-10 Thomson Ave., Long Island City, N. Y.
Gale Dorothea Mechanisms, Inc., 81-01 Broadway, Elmhurst, N. Y.
Kupfrian Mfg. Co., 139 Prospect Ave., Binghamton, N. Y.
Magnetic Amplifiers, Inc., 632 Tinton Ave., New York 55, N. Y.
Manning, Maxwell & Moore, Inc., Stratford, Conn.
NUCLEAR RESEARCH & DEVELOPMENT INC., 1004 Sutter Ave., St. Louis, Mo. ADV. PG. 103
Radiation Counter Labs., Inc., 1844 W. 21st St., Chicago 8, Ill.
Radioisotope Application Co., 1843 University Ave., Berkeley 3, Calif.
Radium Chemical Co., 161 E. 42nd St., New York 17, N. Y.
Reeves Instrument Corp., 215 E. 91st St., New York 28, N. Y.
Scientific Service, Inc., 1417 Solano Ave., Albany, Calif.
SERVOMECHANISMS, INC., Post & Stewart Aves., Westbury, N. Y. ADV. PG. 109
Square Root Mfg. Corp., 391 Saw Mill River Rd., Yonkers, N. Y.
TECHNICAL OPERATIONS, INC., 6 Schouler Court, Arlington 74, Mass. ADV. PG. 128
Telectro Industries Corp., 35-18 37th St., Long Island City 1, N. Y.
TRAERLAB, INC., 130 High St., Boston 10, Mass. ADV. PG. 24

RESISTORS

NOTE: Various types of resisters are not indicated in this listing. Contact manufacturer for specific type(s) desired.

Acme Electric Heating Co., Inc., 1205 Washington St., Boston, Mass.
Aerovox Corp., 740 Belleville Ave., New Bedford, Mass.
Allen-Bradley Co., 136 W. Greenfield Ave., Milwaukee 4, Wis.
Allied Radio Corp., 833 W. Jackson Blvd., Chicago 7, Ill.
Assembly Products, Inc., Chagrin Falls 6, Ohio
Bird Electronic Corp., 1800 E. 38th St., Cleveland 14, Ohio
Bond Electronics Corp., 60 Springfield Ave., Springfield, N. J.
Borg Corp., George W., Borg Equipment Div., Janesville, Wis.
Brown Electro-Measurement Corp., 4637 SE Hawthorne Blvd., Portland 15, Ore.
Carboloy Department of General Electric Co., 11139 East Eight Mile Blvd., Detroit 32, Mich.
Carborundum Co., Globar Div., Niagara Falls, N. Y.
Cinch Corp., 119 Braintree St., Allston 34, Mass.
Cinema Engineering Co., 1510 W. Verdugo Ave., Burbank, Calif.
Clark Controller Co., 1146 E. 152nd St., Cleveland 10, Ohio
Clarostat Mfg. Co., Inc., Dover, New Hampshire
Cole Instrument Co., 1320 S. Grand Ave., Los Angeles 15, Calif.
Cutler-Hammer, Inc., 412 N. 12th St., Milwaukee 1, Wis.
Daven Co., 191 Central Ave., Newark 4, N. J.
Edcliff Instruments, 850 S. Fair Oaks Ave., Pasadena, Calif.
Electro-Mec Laboratory, 19 Murray St., New York 7, N. Y.
Erie Resistor Corp., 644 W. 12th St., Erie, Pa.
GENERAL ELECTRIC CO., Apparatus Sales Div., Schenectady 5, N. Y. ADV. PGS. 2-5
General Radio Co., 275 Massachusetts Ave., Cambridge 39, Mass.

NUCLEAR AND ALLIED PRODUCTS

Giannini & Co., G. M., 254 W. Colorado St., Pasadena 1, Calif.
Hallett Mfg. Co., 1601 Florence Ave., Inglewood, Calif.
Hardwick, Hindle, Inc., 40 Harmon St., Newark 5, N. J.
HELIPOT CORP., 916 Meridian Ave., South Pasadena, Calif. ADV. PG. 27
Hi-Q Division, Aerovox Corp., Seneca Ave., Olean, N. Y.
Hycor Co., Inc., 11423 Vanowen St., North Hollywood, Calif.
I-T-E Circuit Breaker Co., 19th & Hamilton Sts., Philadelphia 30, Pa.
Instrument Resistors Co., 1036 Commerce Ave., Union, N. J.
INTERNATIONAL RESISTANCE CO., 401 N. Broad St., Philadelphia 8, Pa. ADV. PG. 21
Keystone Carbon Co., Inc., Saint Marys, Pa.
Lectrohm, Inc., 5561 Northwest Highway, Chicago 30, Ill.
Mallory & Co., Inc., P. R., 3029 E. Washington St., Indianapolis 6, Ind.
Measurement Engineering Ltd., Arnprior, Ontario, Canada
Mepco Inc., 35–37 Abbott Ave., Morristown, N. J.
Micro-Circuits Co., New Buffalo, Mich.
Muirhead & Co., Ltd., Beckenham, Kent, England
Ohmite Mfg. Co., 4835 W. Flournoy St., Chicago 44, Ill.
Phaostron Co., 151 Pasadena Ave., South Pasadena, Calif.
Polytechnic Research & Development Co., 55 Johnson St., Brooklyn 1, N. Y.
RESISTANCE PRODUCTS CO., 714 Race St., Harrisburg 2, Pa. ADV. PG. 127
Resistors, Inc., 5226 W. 26th St. Chicago 50, Ill.
ROCKBAR CORP., 211 E. 37th St., New York 16, N. Y. ADV. PG. 129
Rubicon Co., Ridge Ave. at 35th St., Philadelphia 32, Pa.
Shallcross Mfg., Co., 10 Jackson Ave., Collingdale, Pa.
Speer Resistor Corp., St. Marys, Pa.
Sprague Electric Co., North Adams, Mass.
Square Root Mfg. Corp., 391 Saw Mill River Rd., Yonkers, N. Y.
Stackpole Carbon Co., St. Marys, Pa.
Supreme, Inc., Greenwood, Miss.
Tech Laboratories, Inc., Bergen & Edsall Blvds., Palisades Park, N. J.
VICTOREEN INSTRUMENT CO., 3800 Perkins Ave., Cleveland 14, Ohio. ADV. PG. Inside Front Cover
Ward Leonard Electric Co., 21 South St., Mt. Vernon, N. Y.
Western Radiation Lab., 1107 W. 24th St., Los Angeles 27, Calif.
Westinghouse Electric Corp., P. O. Box 868, Pittsburgh 30, Pa.
White Dental Mfg. Co., S. S., 10 East 40th St., New York 16, N. Y.
Wilkor Division, Aerovox Corp., 2882 Detroit Ave., Cleveland 13, Ohio
Winslow Co., Inc., 9 Liberty St., Newark, N. J.
Wirt Co., 5221 Greene St., Philadelphia 44, Pa.

RHEOSTATS

Allen-Bradley Co., 136 W. Greenfield Ave., Milwaukee 4, Wis.
Allied Radio Corp., 833 W. Jackson Blvd., Chicago 7, Ill.
Biddle Co., James G., 1316 Arch St., Philadelphia 7, Pa.
Brown Electro-Measurement Corp., 4637 SE Hawthorne Blvd., Portland 15, Ore.
Central Scientific Co., 1700 Irving Park Rd., Chicago 13, Ill.
Centralab Division of Globe-Union, Inc., 900 E. Keefe Ave., Milwaukee 1, Wis.
Clark Controller Co., 1146 132nd St., Cleveland 10, Ohio
Clarostat Mfg. Co., Inc., Dover, New Hampshire
Cutler-Hammer, Inc., 412 N. 12th St., Milwaukee 1, Wis.
Daven Co., 191 Central Ave., Newark 4, N. J.
Dayton Electric Mfg. Co., 748 W. Adams, Chicago, Ill.
DeJur-Amsco Corp., 45-01 Northern Blvd., Long Island City 1, N. Y.
Edcliff Instruments, 850 S. Fair Oaks Ave., Pasadena, Calif.
Electro-Mec Laboratory, 19 Murray St., New York 7, N. Y.
GENERAL ELECTRIC CO., Apparatus Sales Div., Schenectady 5, N. Y. ADV. PGS. 2–5
General Radio Co., 275 Massachusetts Ave., Cambridge 39, Mass.
Hardwick, Hindle, Inc., 40 Harmon St., Newark 5, N. J.
HELIPOT CORP., 916 Meridian Ave., South Pasadena, Calif. ADV. PG. 27
Mallory & Co., Inc., P. R., 3029 E. Washington St., Indianapolis 6, Ind.
Ohmite Mfg. Co., 4835 W. Flournoy St., Chicago 44, Ill.
Shallcross Mfg. Co., 10 Jackson Ave., Collingdale, Pa.
Square Root Mfg. Corp., 391 Saw Mill River Rd., Yonkers, N. Y.
Stackpole Carbon Co., St. Mary's, Pa.
Sticht, Inc., Herman H., 27 Park Place, New York 7, N. Y.
Tech Laboratories, Inc., Bergen & Edsall Blvds., Palisades Park, N. J.
Vulcan Electric Co., 88 Holton St., Danvers, Mass.
Ward Leonard Electric Co., 21 South St., Mt. Vernon, N. Y.
Welch Scientific Co., W. M., 1515 Sedgwick St., Chicago 10, Ill.
Westinghouse Electric Corp., P. O. Box 868, Pittsburgh 30, Pa.

RINGS—Absorption Fractionating

Daylight Vacuum Products Co., 5207 N. Milwaukee Ave., Chicago 30, Ill.
Knight, Maurice A., 171 Kelly Ave., Akron, Ohio
U. S. Stoneware Co., Akron 9, Ohio

RODS—Hard Rubber

Luzerne Rubber Co., Dewey St., Trenton, N. J.
U. S. Rubber Co., 1230 Avenue of the Americas, New York 20, N. Y.

ROOMS—Shielded Screen

Ace Engineering & Machine Co., Inc., 3642 N. Lawrence St., Philadelphia 40, Pa.
Lindgren & Associates, Erik A., 4515–17 N. Ravenswood Ave., Chicago 40, Ill.
Shielding, Inc., Riverside Park, N. J.

SAMPLE HOLDERS & CHANGERS

ANTON ELECTRONIC LABS., INC., 1226–38 Flushing Ave., Brooklyn 37, N. Y. ADV. PG. 136
ATOMIC INSTRUMENT CO., 84 Massachusetts Ave., Cambridge 39, Mass. ADV. PG. 23
Atomlab, Inc., 489 Fifth Ave., New York 17, N. Y.
Daylight Vacuum Products Co., 5207 N. Milwaukee Ave., Chicago 30, Ill.
Douglas Radio Labs., 176 Norfolk Ave., Boston 19, Mass.
El-Tronics, Inc., 2649 N. Howard St., Philadelphia 33, Pa.
NUCLEAR INSTRUMENT & CHEMICAL CO., 223 W. Erie St., Chicago 10, Ill. ADV. PG. Back Cover
NUCLEAR RESEARCH CORP., 2563 Grays Ferry Ave., Philadelphia 46, Pa. ADV. PG. 97
NUCLEONIC CO. OF AMERICA, 497 Union St., Brooklyn 31, N. Y. ADV. PG. 112
Radiation Counter Labs., Inc., 1844 W. 21st St., Chicago 8, Ill.
TECHNICAL ASSOCIATES, INC., 140 W. Providencia Ave., Burbank, Calif. ADV. PG. 130
TRACERLAB, INC., 130 High St., Boston 10, Mass. ADV. PG. 24

SCALERS—Binary

Air Associates, Inc., Teterboro, N. J.
ANTON ELECTRONIC LABS., INC., 1226–38 Flushing Ave., Brooklyn 37, N. Y. ADV. PG. 136
ATOMIC INSTRUMENT CO., 84 Massachusetts Ave., Cambridge 39, Mass. ADV., PG. 23
Atomlab, Inc., 489 Fifth Ave., New York 17, N. Y.
Cinema Television Ltd., Worsley Bridge Rd., London, S. E. 26, England
Computer Research Corp., 3348 W. El Segundo Blvd., Hawthorne, Calif.
Douglas Radio Labs., 176 Norfolk Ave., Boston 19, Mass.
El-Tronics, Inc., 2649 N. Howard St., Philadelphia 33, Pa.
General Electric Co., Electronics Div., Electronics Park, Syracuse, N. Y.
NUCLEAR INSTRUMENT & CHEMICAL CORP., 223 W. Erie St., Chicago 10, Ill. ADV. PG. Back Cover
Nuclear Measurements Corp., 2460 N. Arlington Ave., Indianapolis 18, Ind.
NUCLEAR RESEARCH & DEVELOPMENT INC., 1094 Sutter Ave., St. Louis, Mo. ADV. PG. 103
NUCLEONIC CO. OF AMERICA, 497 Union St., Brooklyn 31, N. Y. ADV. PG. 112
Potter Instrument Co., 115 Cutter Mill Rd., Great Neck, N. Y.
R-C SCIENTIFIC INSTRUMENT CO., 335 Culver Blvd., Playa Del Rey, Calif. ADV. PG. 129
Radiation Counter Labs., Inc., 1844 W. 21st St., Chicago 8, Ill.
RADIATION INSTRUMENT DEVELOPMENT LAB., 2337 W. 67th St., Chicago 36, Ill. ADV. PG. Inside Back Cover
RADIOACTIVE PRODUCTS, INC., 443 W. Congress St., Detroit, Mich. ADV. PG. 8
Rutherford Electronics Corp., 3707 S. Robertson Blvd., Culver City, Calif.
TECHNICAL ASSOCIATES, INC., 140 W. Providencia Ave., Burbank, Calif. ADV. PG. 130
TRACERLAB, INC., 130 High St., Boston 10, Mass. ADV. PG. 24
Wanlkirt Co., 145 W. Hazel, Inglewood, Calif.
Wang Laboratories, 296 Columbus Ave., Boston 16, Mass.

SCALERS—Decade

Air Associates, Inc., Teterboro, N. J.
ANTON ELECTRONIC LABS., INC., 1226–38 Flushing Ave., Brooklyn 37, N. Y. ADV. PG. 136
ATOMIC INSTRUMENT CO., 84 Massachusetts Ave., Cambridge 39, Mass. ADV. PG. 23
Atomlab, Inc., 489 Fifth Ave., New York 17, N. Y.
Berkeley Scientific Div. of Beckman Instruments, 2200 Wright Ave., Richmond, Calif.
Canadian Marconi Co., P. O. Box 1690 (Place D'Armes), Montreal, Quebec, Canada
Cinema Television Ltd., Worsley Bridge Rd., London, S. E. 26, England
COLE, LTD., E. K., Electronics Div., Malmesbury, Wiltshire, England. ADV. PG. 28
Computer Research Corp., 3348 W. El Segundo Blvd., Hawthorne, Calif.
Cyclotron Specialties Co., Moraga 8, Calif.
Detectron Co., 5631 Cahuenga Blvd., North Hollywood, Calif.
Douglas Radio Labs., 176 Norfolk Ave., Boston 19, Mass.
El-Tronics, Inc., 2649 N. Howard St., Philadelphia 33, Pa.
Hewlett-Packard Co., 395 Page Mill Rd., Palo Alto, Calif.
NUCLEAR INSTRUMENT & CHEMICAL CORP., 223 W. Erie St., Chicago 10, Ill. ADV. PG. Back Cover
Nuclear Measurements Corp., 2460 N. Arlington Ave., Indianapolis 18, Ind.
NUCLEONIC CO. OF AMERICA, 497 Union St., Brooklyn 31, N. Y. ADV. PG. 112
Potter Instrument Co., 115 Cutter Mill Rd., Great Neck, N. Y.
Radiation Counter Labs., Inc., 1844 W. 21st St., Chicago 8, Ill.
RADIATION INSTRUMENT DEVELOPMENT LAB., 2337 W. 67th St., Chicago 36, Ill. ADV. PG. Inside Back Cover
RADIOACTIVE PRODUCTS, INC., 443 W. Congress St., Detroit, Mich. ADV. PG. 8
Rutherford Electronics Corp., 3707 S. Robertson Blvd., Culver City, Calif.
TECHNICAL ASSOCIATES, INC., 140 W. Providencia Ave., Burbank, Calif. ADV. PG. 130
TRACERLAB, INC., 130 High St., Boston 10, Mass. ADV. PG. 24
Wanlkirt Co., 145 W. Hazel, Inglewood, Calif.
Wang Laboratories, 296 Columbus Ave., Boston 16, Mass.

SCALES—Laboratory

American Instrument Co., Inc., 8030 Georgia Ave., Silver Spring, Md.
BURKE & JAMES, INC., 321 S. Wabash Ave., Chicago 4, Ill. ADV. PG. 133
Central Scientific Co., 1700 Irving Park Rd., Chicago 13, Ill.
Colloid Equipment Co., Inc., 50 Church St., New York 7, N. Y.
Detectron Co., 5631 Cahuenga Blvd., North Hollywood, Calif.
Eberbach Corporation, Ann Arbor, Mich.
Exact Weight Scale Co., 944 W. 5th Ave., Columbus 8, Ohio
Fisher Scientific Co., 709 Forbes St., Pittsburgh 19, Pa.
Gaertner Scientific Corp., 1237 Wrightwood Ave., Chicago, Ill.
Humboldt Mfg. Co., 2814 N. Whipple St., Chicago 47, Ill.
Ohaus Scale Co., 1050 Commerce Ave., Union, N. J.
Welch Scientific Co., W. M., 1515 Sedgwick St., Chicago 10, Ill.
Yonkers Laboratory Supply Co., 70 Palisade Ave., Yonkers 2, N. Y.

SCALES—Platform

Colloid Equipment Co., Inc., 50 Church St., New York 7, N. Y.
Exact Weight Scale Co., 944 W. Fifth Ave., Columbus 8, Ohio
Humboldt Mfg. Co., 2814 N. Whipple St., Chicago 47, Ill.
Ohaus Scale Corp., 1050 Commerce Ave., Union, N. J.
Streeter-Amet Co., 4101 Ravenswood Ave., Chicago 13, Ill.

SCALES—Spring

Colloid Equipment Co., Inc., 50 Church St., New York 7, N. Y.
Humboldt Mfg. Co., 2814 N. Whipple St., Chicago 47, Ill.
Welch Scientific Co., W. M., 1515 Sedgwick St., Chicago 10, Ill.

SCREENS—Laboratory

RAB-RAY PRODUCTS, INC., 209 25th St., Brooklyn 32, N. Y. ADV. PG. 112
Emerson-Sack-Warner Corp., 150 Dorchester Ave., South Boston 23, Mass.

Humboldt Mfg. Co., 2814 N. Whipple St., Chicago 47, Ill.
Jelliff Mfg. Corp., C. O., 122 Pequot Ave., Southport, Conn.
Newark Wire Cloth Co., 351 Verona Ave., Newark 4, N. J.
Precision Scientific Co., 3737 W. Cortland St., Chicago 47, Ill.

SCREENS, SIEVES

Cave & Co., Ltd., 567 Hornby St., Vancouver, B. C., Canada
Humboldt Mfg. Co., 2814 N. Whipple St., Chicago 47, Ill.
Jelliff Mfg. Corp., C. O., 122 Pequot Ave., Southport, Conn.
National Spectrographic Labs., Inc., 6300 Euclid Ave., Cleveland 3, Ohio
Newark Wire Cloth Co., 351 Verona Ave., Newark 4, N. J.
Syntron Corp., 355 Lexington, Homer City, Pa.
U. S. GASKET CO., 602 N. 10th St., Camden, N. J. ADV. PG. 135
Yonkers Laboratory Supply Co., 70 Palisade Ave., Yonkers 2, N. Y.

SCREENS—X-Ray

BAR-RAY PRODUCTS, INC., 209 25th St., Brooklyn 32, N. Y. ADV. PG. 112
du Pont de Nemours & Co., Inc., E. I., Wilmington 98, Del.
Eastman Kodak Co., Rochester 4, N. Y.
Emerson-Sack-Warner Corp., 150 Dorchester Ave., South Boston 23, Mass.
Mullard Overseas Ltd., Century House, Shaftesbury Ave., London W. C. 2, England
Picker X-Ray Corp., 25 S. Broadway, White Plains, N. Y.
St. John X-Ray Laboratory, Califon, N. J.
U. S. Radium Corp., 535 Pearl St., New York 7, N. Y.
Universal X-Ray Products, Inc., 1140 N. Western Ave., Chicago 22, Ill.
X-Ray Department of General Electric Co., 4855 Electric Ave., Milwaukee 1, Wis.

SERVOMECHANISMS

AERONAUTICAL RESEARCH LABS., GENERAL MILLS, INC., 2010 E. Hennepin Ave., Minneapolis 13, Minn. ADV. PG. 99
Askania Regulator Co., 240 E. Ontario St., Chicago 11, Ill.
Atomlab, Inc., 489 Fifth Ave., New York 17, N. Y.
Audio Instrument Co., 133 W. 14th St., New York 11, N. Y.
Avion Instrument Corp., Paramus, N. J.
Bogue Electric Mfg. Co., 32 Iowa Ave., Paterson 3, N. J.
Borg Corp., George W., Borg Equipment Div., Janesville, Wis.
Doelcam Corp., 56 Elmwood St., Newton, Mass.
Ford Instrument Co., 31-10 Thomson Ave., Long Island City, N. Y.
GENERAL ELECTRIC CO., Apparatus Sales Div., Schenectady 5, N. Y. ADV. PGS. 2-5
Industrial Control Co., Straight Path & Arlington Ave., Wyandanch, N. Y.
Lavoie Laboratories, Morganville, N. J.
Magnetic Amplifiers, Inc., 632 Tinton Ave., New York 55, N. Y.
Minnesota Electronics Corp., 47 W. Water St., St. Paul 1, Minn.
Muirhead & Co., Ltd., Beckenham, Kent, England
Pacific Division, Bendix Aviation Corp., 11600 Sherman Way, North Hollywood, Calif.
Raytheon Mfg. Co., Equipment Sales Div., Waltham 54, Mass.
Reeves Instrument Corp., 215 E. 91st St., New York 28, N. Y.
Robinette Co., W. C., 802 Fair Oaks Ave., South Pasadena, Calif.
Sanders Associates, Inc., Nashua, N. H.
Servo Corp. of America, 2020 Jericho Turnpike, New Hyde Park, N. Y.
SERVOMECHANISMS, INC., Post & Stewart Aves., Westbury, N. Y. ADV. PG. 109
Specialties, Inc., Skunks Misery Road, Syosset, N. Y.
Square Root Mfg. Corp., 391 Saw Mill River Rd., Yonkers, N. Y.
Standard Electronics Research Corp., 2 East End Ave., New York 21, N. Y.
Trans-Sonics, Inc., Bedford Airport, Bedford, Mass.
Vectron, Inc., 400 Main St., Waltham 54, Mass.
Vickers Electric Division, Vickers, Inc., 1815 Locust St., St. Louis, Mo.

SHAKERS

Central Scientific Co., 1700 Irving Park Rd., Chicago 13, Ill.
Eberbach Corporation, Ann Arbor, Mich.
Fisher Scientific Co., 709 Forbes St., Pittsburgh 19, Pa.
Humboldt Mfg. Co., 2814 N. Whipple St., Chicago 47, Ill.
International Equipment Co., 1284 Soldiers Field Rd., Boston 35, Mass.
Precision Scientific Co., 3737 W. Cortland St., Chicago 47, Ill.
Sargent & Co., E. H., 4647 W. Foster Ave., Chicago 30, Ill.
Syntron Corp., 355 Lexington, Homer City, Pa.
Yonkers Laboratory Supply Co., 70 Palisade Ave., Yonkers 2, N. Y.

SHEETS—Hard Rubber

BAR-RAY PRODUCTS, INC., 209 25th St., Brooklyn 32, N. Y. ADV. PG. 112
Felt Products Mfg. Co., 1504 W. Carroll Ave., Chicago 7, Ill.
Goodyear Tire & Rubber Co., Akron, Ohio
Luzerne Rubber Co., Dewey St., Trenton, N. J.
U. S. Rubber Co., 1230 Avenue of the Americas, New York 20, N. Y.

SHIELDED SCREEN ROOMS

See ROOMS—Shielded Screen

SHIELDING—Radiation

ATOMIC INSTRUMENT CO., 84 Massachusetts Ave., Cambridge 39, Mass. ADV. PG. 23
Atomlab, Inc., 489 Fifth Ave., New York 17, N. Y.
BAR-RAY PRODUCTS, INC., 209 25th St., Brooklyn 32, N. Y. ADV. PG. 112
Buffalo Weaving & Belting Co., Buffalo 7, N. Y.
COLE, LTD., E. K., Electronics Div., Malmesbury, Wiltshire, England. ADV. PG. 28
Division Lead Co., 836 W. Kinzie St., Chicago 22, Ill.
ISOTOPE SPECIALTIES CO., 3816 San Fernando Rd., Glendale, Calif. ADV. PG. 94
Mallory & Co., Inc., P. R., 3029 E. Washington St., Indianapolis 6, Ind.
National Lead Co., 111 Broadway, New York 6, N. Y.
NUCLEAR INSTRUMENT & CHEMICAL CORP., 223 W. Erie St., Chicago 10, Ill. ADV. PG. Back Cover
NUCLEAR RESEARCH CORP., 2563 Grays Ferry Ave., Philadelphia 46, Pa. ADV. PG. 97
NUCLEONIC CO. OF AMERICA, 497 Union St., Brooklyn 31, N. Y. ADV. PG. 112
PENBERTHY INSTRUMENT CO., HI-D DIVISION, 666 Adams St., Seattle 8, Wash. ADV. PGS. 127, 134
R-C SCIENTIFIC INSTRUMENT CO., 335 Culver Blvd., Playa Del Rey, Calif. ADV. PG. 129
Radiation Counter Labs., Inc., 1844 W. 21st St., Chicago 8, Ill.
Radioisotope Application Co., 1843 University Ave., Berkeley 3, Calif.
Radium Chemical Co., 161 E. 42nd St., New York 17, N. Y.
St. John X-Ray Laboratory, Califon, N. J.
Scientific Service, Inc., 1417 Solano Ave., Albany, Calif.
TRACERLAB, INC., 130 High St., Boston 10, Mass. ADV. PG. 24
Western Radiation Lab., 1107 W. 24th St., Los Angeles 27, Calif.

SILICONE GREASE

Clarkstan Corp., 11921 SW Pico Blvd., Los Angeles 64, Calif.
Dow Corning Corp., Midland, Mich.
Emerson & Cuming Co., 126 Massachusetts Ave., Boston 15, Mass.
General Electric Co., Chemical Div., 1 Plastics Ave., Pittsfield, Mass.

SILICONE RUBBER

Auburn Mfg. Co., 500 Stack St., Middletown, Conn.
Connecticut Hard Rubber Co., New Haven 9, Conn.
Dow Corning Corp., Midland, Mich.
Felt Products Mfg. Co., 1504 W. Carroll Ave., Chicago 7, Ill.
General Electric Co., Chemical Div., 1 Plastics Ave., Pittsfield, Mass.
Irvington Varnish & Insulator Co., 10 Argyle Terrace, Irvington, N. J.
Republic Rubber Division of Lee Rubber & Tire Corp., Youngstown, Ohio

SINKS—Laboratory

Alberene Stone Corp. of Virginia, 419 Fourth Ave., New York 16, N. Y.
Alco Scientific Div. of A. S. Aloe Co., 5655 Kingsbury Blvd., St. Louis 12, Mo.
BAR-RAY PRODUCTS, INC., 209 25th St., Brooklyn 32, N. Y. ADV. PG. 112
BLICKMAN, INC., S., 7900 Gregory Ave., Weehawken, N. J. ADV. PG. 30
Brooklyn Hospital Equipment Co., Inc., 196 Lexington Ave., Brooklyn, N. Y.
Consolidated Siphon Supply Co., Inc., 24 Wooster St., New York, N. Y.
Division Lead Co., 836 W. Kinzie St., Chicago 22, Ill.
Elmer & Amend Div. of Fisher Scientific Co., 635 Greenwich St., New York, N. Y.
Emerson-Sack-Warner Corp., 150 Dorchester Ave., South Boston 23, Mass.
Fisher Scientific Co., 709 Forbes Ave., Pittsburgh 19, Pa.
Knight, Maurice A., 171 Kelly Ave., Akron, Ohio
Metal Products Corp., 48 W. 19th St., Weehawken, N. J.
Metalab Equipment Corp., 270 Duffy Ave., Hicksville, N. Y.
Pabst Engineering Equipment Co., Inc., Elizabeth, N. J.
U. S. Stoneware Corp., Akron 9, Ohio

SOURCES—Radioactivity

Allied Radio Corp., 833 W. Jackson Blvd., Chicago 7, Ill.
ATOMIC ENERGY OF CANADA, LTD., Commercial Products Div., P. O. Box 93, Ottawa, Ontario, Canada. ADV. PG. 18
Atomlab, Inc., 489 Fifth Ave., New York 17, N. Y.
CANADIAN RADIUM & URANIUM CORP., 630 Fifth Ave., New York 20, N. Y. ADV. PG. 116
El-Tronics, Inc., 2649 N. Howard St., Philadelphia 33, Pa.
Finkle, Raymond D., 2633 Santa Monica Blvd., Santa Monica, Calif.
Isotope Products Ltd., Davis Rd., P. O. Box 127, Oakville, Ontario, Canada
ISOTOPE SPECIALTIES CO., 3816 San Fernando Rd., Glendale, Calif. ADV. PG. 94
NUCLEAR INSTRUMENT & CHEMICAL CORP., 223 W. Erie St., Chicago 10, Ill. ADV. PG. Back Cover
Nuclear Measurements Corp., 2460 N. Arlington Ave., Indianapolis 18, Ind.
NUCLEAR RESEARCH CORP., 2563 Grays Ferry Ave., Philadelphia 46, Pa. ADV. PG. 97
NUCLEAR RESEARCH & DEVELOPMENT INC., 1094 Sutter Ave., St. Louis, Mo. ADV. PG. 103
PENBERTHY INSTRUMENT CO., HI-D DIVISION, 666 Adams St., Seattle 8, Wash. ADV. PGS. 127, 134
R-C SCIENTIFIC INSTRUMENT CO., 335 Culver Blvd., Playa Del Rey, Calif. ADV. PG. 129
Radium Chemical Co., 161 E. 42nd St., New York 17, N. Y.
TECHNICAL ASSOCIATES, INC., 140 W. Providencia Ave., Burbank, Calif. ADV. PG. 130
TECHNICAL OPERATIONS, INC., 6 Schouler Court, Arlington 74, Mass. ADV. PG. 128
TRACERLAB, INC., 130 High St., Boston 10, Mass. ADV. PG. 24
U. S. Radium Corp., 535 Pearl St., New York 7, N. Y.

SPECTROGRAPHS

Applied Research Labs., 4336 San Fernando Rd., Glendale 4, Calif.
Baird Associates, Inc., 33 University Rd., Cambridge 38, Mass.
Bausch & Lomb Optical Co., 630 St. Paul St., Rochester 2, N. Y.
Central Scientific Co., 1700 Irving Park Rd., Chicago 13, Ill.
Fisher Scientific Co., 709 Forbes Ave., Pittsburgh 19, Pa.
Gaertner Scientific Corp., 1237 Wrightwood Ave., Chicago, Ill.
Jarrell-Ash Co., 165 Newberry St., Boston 16, Mass.
North American Philips Co., Inc., 100 E. 42nd St., New York 17, N. Y.
Perkin-Elmer Corp., Norwalk, Conn.

SPECTROMETERS

American Optical Co., Instrument Div., Buffalo 15, N. Y.
Applied Research Labs., 4336 San Fernando Rd., Glendale 4, Calif.
Atomlab, Inc., 489 Fifth Ave., New York 17, N. Y.
Baird Associates, Inc., 33 University Rd., Cambridge 38, Mass.
Bausch & Lomb Optical Co., 630 St. Paul St., Rochester 2, N. Y.
Consolidated Engineering Corp., 300 N. Sierra Madre Villa, Pasadena 8, Calif.
Daylight Vacuum Products Co., 5207 N. Milwaukee Ave., Chicago 30, Ill.
Farrand Optical Co., Inc., Bronx Blvd. at E. 238th St., New York 70, N. Y.
Gaertner Scientific Corp., 1237 Wrightwood Ave., Chicago, Ill.
Jarrell-Ash Co., 165 Newberry St., Boston 16, Mass.
Perkin-Elmer Corp., Norwalk, Conn.
Phoenix Precision Instrument Co., 3803-05 N. 5th St., Philadelphia, Pa.
VICTOREEN INSTRUMENT CO., 3800 Perkins Ave., Cleveland 14, Ohio. ADV. PG. Inside Front Cover
Welch Scientific Co., W. M., 1515 Sedgwick St., Chicago 10, Ill.

SPECTROMETERS—Mass

Consolidated Engineering Corp., 300 N. Sierra Madre Villa, Pasadena 8, Calif.

Daylight Vacuum Products Co., 5207 N. Milwaukee Ave., Chicago 30, Ill.
GENERAL ELECTRIC CO., Apparatus Sales Div., Schenectady 5, N. Y. ADV. PGS. 2–5
Measurement Engineering Ltd., Arnprior, Ontario, Canada
Process & Instruments, 60 Greenpoint Ave., Brooklyn 22, N. Y.
Vacuum-Electronic Engineering Co., 86 Denton Ave., New Hyde Park, N. Y.

SPECTROPHOTOMETERS

American Instrument Co., Inc., 8030 Georgia Ave., Silver Spring, Md.
American Optical Co., Instrument Div., Buffalo 15, N. Y.
Applied Physics Corp., 362 W. Colorado St., Pasadena 1, Calif.
Baird Associates, Inc., 33 University Rd., Cambridge 38, Mass.
Bausch & Lomb Optical Co., 630 St. Paul St., Rochester 2, N. Y.
Beckman Instruments, Inc., 820 Mission St., South Pasadena 183, Calif.
Biddle Co., James G., 1316 Arch St., Philadelphia 7, Pa.
Central Scientific Co., 1700 Irving Park Rd., Chicago 13, Ill.
Coleman Instruments, Inc., Maywood, Ill.
Farrand Optical Co., Inc., Bronx Blvd. at E. 238th St., New York 70, N. Y.
Gaertner Scientific Corp., 1237 Wrightwood Ave., Chicago, Ill.
GENERAL ELECTRIC CO., Apparatus Sales Div., Schenectady 5, N. Y. ADV. PGS. 2–5
Jarrell-Ash Co., 365 Newberry St., Boston 16, Mass.
Leeds & Northrup Co., 4970 Stenton Ave., Philadelphia 44, Pa.
Libroscope, Inc., 1607 Flower St., Glendale 1, Calif.
Perkin-Elmer Corp., Norwalk, Conn.
Photovolt Corp., 95 Madison Ave., New York 16, N. Y.
Process & Instruments, 60 Greenpoint Ave., Brooklyn 22, N. Y.

STANDARDS—Radioactivity

ATOMIC ENERGY OF CANADA, LTD., Commercial Products Div., P. O. Box 93, Ottawa, Ontario, Canada. ADV. PG. 18
Atomlab, Inc., 489 Fifth Ave., New York 17, N. Y.
CANADIAN RADIUM & URANIUM CORP., 630 Fifth Ave., New York 20, N. Y. ADV. PG. 116
El-Tronics, Inc., 2649 N. Howard St., Philadelphia 33, Pa.
Finkle, Raymond D., 2633 Santa Monica Blvd., Santa Monica, Calif.
ISOTOPE SPECIALTIES CO., 3816 San Fernando Rd., Glendale, Calif. ADV. PG. 94
B-C SCIENTIFIC INSTRUMENT CO., 335 Culver Blvd., Playa Del Rey, Calif. ADV. PG. 129
Radium Chemical Co., 161 E. 42nd St., New York 17, N. Y.
TECHNICAL ASSOCIATES, INC., 140 W. Providencia Ave., Burbank, Calif. ADV. PG. 130
TECHNICAL OPERATIONS, INC., 6 Schouler Court, Arlington 74, Mass. ADV. PG. 128
TRACERLAB, INC., 130 High St., Boston 10, Mass. ADV. PG. 24
U. S. Radium Corp., 535 Pearl St., New York 7, N. Y.

STANDS—Titration

Emerson-Sack-Warner Corp., 150 Dorchester Ave., South Boston 23, Mass.
Fisher Scientific Co., 709 Forbes Ave., Pittsburgh 19, Pa.
Hamilton Mfg. Co., Two Rivers, Wis.
Mullard Overseas Ltd., Century House, Shaftesbury Ave., London W. C. 2, England
Philpot & Bird, Inc., 303 S. 6th St., Richmond 5, Va.
Precision Scientific Co., 3737 W. Cortland St., Chicago 47, Ill.
Sargent & Co., E. H., 4647 W. Foster Ave., Chicago 30, Ill.
Yonkers Laboratory Supply Co., 70 Palisade Ave., Yonkers 2, N. Y.

STERILIZERS

Aetna Scientific Co., Second & Spring Sts., Everett 49, Mass.
American Instrument Co., Inc., 8030 Georgia Ave., Silver Spring, Md.
Central Scientific Co., 1700 Irving Park Rd., Chicago 13, Ill.
Electric Heat Control Apparatus Co., 27 N. J. R. R. Ave., Newark 5, N. J.
Falk & Co., Ltd., M., 5 Victoria St., London, S. W. 1, England
General Dyestuff Corp., 435 Hudson St., New York 14, N. Y.
Mathieson Chemical Corp., Mathieson Bldg., Baltimore 3, Md.
National Appliance Co., Swan Island, Portland 18, Ore.
Patton & Crane Co., 632 Harper Ave., Detroit, Mich.
Precision Scientific Co., 3737 W. Cortland St., Chicago 47, Ill.
Yonkers Laboratory Supply Co., 70 Palisade Ave., Yonkers 2, N. Y.

STILLS—Distilled Water

Aetna Scientific Co., Second & Spring Sts., Everett 49, Mass.
American Copper & Brass Works, Inc., Cincinnati 2, Ohio
Barnstead Still & Sterilizer Co., 222 Lanesville Terrace, Forest Hills, Boston 31, Mass.
Brighton Copper Works, Inc., 2146 Colerain Ave., Cincinnati, Ohio
Daylight Vacuum Products Co., 5207 N. Milwaukee Ave., Chicago 30, Ill.
Electric Hotpack Co., Inc., 5035 Cottman Ave., Philadelphia, Pa.
Emerson-Sack-Warner Corp., 150 Dorchester Ave., South Boston 23, Mass.
Illinois Water Treatment Co., 858 Cedar St., Rockford, Ill.
Precision Scientific Co., 3737 W. Cortland St., Chicago 47, Ill.
STOKES MACHINE CO., F. J., Frankford Station P. O., Philadelphia 20, Pa. ADV. PG. 117
Yonkers Laboratory Supply Co., 70 Palisade Ave., Yonkers 2, N. Y.

STILLS—Laboratory

Aetna Scientific Co., Second & Spring Sts., Everett 49, Mass.
American Copper & Brass Works, Inc., Cincinnati 2, Ohio
Barnstead Still & Sterilizer Co., 222 Lanesville Terrace, Forrest Hills, Boston 31, Mass.
Brighton Copper Works, Inc., 2146 Colerain Ave., Cincinnati, Ohio
Colloid Equipment Co., Inc., 50 Church St., New York 7, N. Y.
Daylight Vacuum Products Co., 5207 N. Milwaukee Ave., Chicago 30, Ill.
Eck & Krebs, Inc., 27–09 40th Ave., Long Island City 1, N. Y.
Elmer & Amend Div. of Fisher Scientific Co., 635 Greenwich St., New York, N. Y.
Electric Hotpack Co., Inc., 5035 Cottman Ave., Philadelphia, Pa.
Emerson-Sack-Warner Corp., 150 Dorchester Ave., South Boston 23, Mass.
Fisher Scientific Co., 709 Forbes Ave., Pittsburgh 19, Pa.
Glass Engineering Laboratories, Belmont, Calif.
Illinois Water Treatment Co., 858 Cedar St., Rockford, Ill.
Pfaudler Co., 1002 West Ave., Rochester, N. Y.
Precision Scientific Co., 3737 W. Cortland St., Chicago 47, Ill.
Scientific Glass Apparatus Co., Inc., 102 Lakewood Terrace, Bloomfield, N. J.
STOKES MACHINE CO., F. J., Frankford Station P. O., Philadelphia 20, Pa. ADV. PG. 117
Will Corp., Rochester 3, N. Y.
Yonkers Laboratory Supply Co., 70 Palisade Ave., Yonkers 2, N. Y.

STIRRERS

American Instrument Co., Inc., 8030 Georgia Ave., Silver Spring, Md.
Consolidated Siphon Supply Co., Inc., 24 Wooster St., New York, N. Y.
Daylight Vacuum Products Co., 5207 N. Milwaukee Ave., Chicago 30, Ill.
Eberbach Corporation, Ann Arbor, Mich.
Mixing Equipment Co., 192 Mt. Read Blvd., Rochester 11, N. Y.
Precision Scientific Co., 3737 W. Cortland St., Chicago 47, Ill.
Sargent & Co., E. H., 4647 W. Foster Ave., Chicago 30, Ill.
Welch Scientific Co., W. M., 1515 Sedgwick St., Chicago 10, Ill.
Yonkers Laboratory Supply Co., 70 Palisade Ave., Yonkers 2, N. Y.

SURVEY METERS

Allied Radio Corp., 833 W. Jackson Blvd., Chicago 7, Ill.
ATOMIC INSTRUMENT CO., 84 Massachusetts Ave., Cambridge 39, Mass. ADV. PG. 23
Atomlab, Inc., 489 Fifth Ave., New York 17, N. Y.
Bristol Co., The, Waterbury 20, Conn.
COLE, LTD., E. K., Electronics Div., Malmesbury, Wiltshire, England. ADV. PG. 28
Detectron Co., 5631 Cahuenga Blvd., North Hollywood, Calif.
El-Tronics, Inc., 2649 N. Howard St., Philadelphia 33, Pa.
Esterline-Angus Co., Inc., P. O. Box 596, Indianapolis 6, Ind.
Falk & Co., Ltd., M., 5 Victoria St., London, S. W. 1, England
GENERAL ELECTRIC CO., Apparatus Sales Div., Schenectady 5, N. Y. ADV. PGS. 2–5
Landswerk Electrometer Co., 550–552 W. Garfield Ave., Glendale 4, Calif.
Nuclear Development Laboratory, P. O. Box 7034, Kansas City, Mo.
NUCLEAR INSTRUMENT & CHEMICAL CORP., 223 W. Erie St., Chicago 10, Ill. ADV. PG. Back Cover
Nuclear Measurements Corp., 2460 N. Arlington Ave., Indianapolis 18, Ind.
NUCLEAR RESEARCH CORP., 2563 Grays Ferry Ave., Philadelphia 46, Pa. ADV. PG. 97
NUCLEONIC CO. OF AMERICA, 497 Union St., Brooklyn 31, N. Y. ADV. PG. 112
Ohmart Corp., The, 2347 Ferguson Ave., Cincinnati 38, Ohio
PRECISION RADIATION INSTRUMENTS, 2235 S. LaBrea Ave., Los Angeles 16, Calif. ADV. PG. 108
B-C SCIENTIFIC INSTRUMENT CO., 335 Culver Blvd., Playa Del Rey, Calif. ADV. PG. 129
Radiation Counter Labs., Inc., 1844 W. 21st St., Chicago 8, Ill.
RADIOACTIVE PRODUCTS, INC., 443 W. Congress St., Detroit 26, Mich. ADV. PG. 8
TECHNICAL ASSOCIATES, INC., 140 W. Providencia Ave., Burbank, Calif. ADV. PG. 130
TRACERLAB, INC., 130 High St., Boston 10, Mass. ADV. PG. 24
VICTOREEN INSTRUMENT CO., 3800 Perkins Ave., Cleveland 14, Ohio. ADV. PG. Inside Front Cover
Western Radiation Lab., 1107 W. 24th St., Los Angeles 27, Calif.

TABLE TOPS—Laboratory

Alberene Stone Corp. of Virginia, 419 Fourth Ave., New York 16, N. Y.
BLICKMAN, INC., S., 7900 Gregory Ave., Weehawken, N. J. ADV. PG. 30
Brooklyn Hospital Equipment Co., Inc., 196 Lexington Ave., Brooklyn, N. Y.
Division Lead Co., 836 W. Kinzie St., Chicago 22, Ill.
Doehler Metal Furniture Co., Inc., 194 Lexington Ave., New York, N. Y.
Elmer & Amend Div. of Fisher Scientific Co., 635 Greenwich St., New York, N. Y.
Emerson-Sack-Warner Corp., 150 Dorchester Ave., South Boston 23, Mass.
Fisher Scientific Co., 709 Forbes Ave., Pittsburgh 19, Pa.
Hamilton Mfg. Co., Two Rivers, Wis.
Keller Products, Inc., Manchester, N. H.
Metalab Equipment Corp., 270 Duffy Ave., Hicksville, N. Y.
Pabst Engineering Equipment Co., Inc., Elizabeth, N. J.
Radioisotope Application Co., 1843 University Ave., Berkley 3, Calif.
Scientific Service, Inc., 1417 Solano Ave., Albany, Calif.
U. S. GASKET CO., 602 N. 10th St., Camden, N. J. ADV. PG. 135

TECHNICAL BOOKS—Publishers

Academic Press Co., 125 E. 23rd St., New York 10, N. Y.
Addison Wesley Press, Kendall Square, Cambridge 42, Mass.
Bender & Co., Matthew, 443 Fourth Ave., New York 16, N. Y.
Blakiston Co., 1012 Walnut St., Philadelphia 5, Pa.
Boyce-Roche Book Co., 460 Bloomfield Ave., Montclair, N. J.
Dover Publications, 1780 Broadway, New York 19, N. Y.
ELECTRONICS RESEARCH PUBLISHING CO., INC., 480 Canal St., New York 13, N. Y. ADV. PG. 133
Institute of Radio Engineers, Inc., 1 E. 79th St., New York, N. Y.
Instruments Publishing Co., 921 Ridge Ave., Pittsburgh 12, Pa.
McGRAW-HILL BOOK CO., INC., 330 W. 42nd St., New York 36, N. Y. ADV. PG. 131
Macmillan Co., The, 60 Fifth Ave., New York 11, N. Y.
Oxford University Press, 114 Fifth Ave., New York, N. Y.
Philosophical Library, 15 E. 40th St., New York, N. Y.
Prentice-Hall Inc., 70 Fifth Ave., New York, N. Y.
Reinhold Publishing Corp., 330 W. 42nd St., New York 36, N. Y.
RIDER PUBLICATIONS INC., JOHN F., 480 Canal St., New York 13, N. Y. ADV. PG. 129
Rinehart Books, Inc., 232 Madison Ave., New York 16, N. Y.
Sams Co., Inc., Howard W., 2201 E. 46th St., Indianapolis 5, Ind.
Universal Scientific Co., Vincennes, Ind.
University of Chicago Press., 5750 Ellis Ave., Chicago 37, Ill.

Van Nostrand Co., Inc., D., 250 Fourth Ave., New York 3, N. Y.
Wiley & Sons Inc., John, 440 Fourth Ave., New York, N. Y.

TELEMETERING SYSTEMS—Electronic

AERONAUTICAL RESEARCH LABS., GENERAL MILLS, INC., 2010 E. Hennepin Ave., Minneapolis 13, Minn. ADV. PG. 99
Applied Science Corp. of Princeton, P. O. Box 44, Princeton, N. J.
ATOMIC INSTRUMENT CO., 84 Massachusetts Ave., Cambridge 39, Mass. ADV. PG. 23
Atomlab, Inc., 489 Fifth Ave., New York 17, N. Y.
Audio Instrument Co., 133 W. 14th St., New York 11, N. Y.
Austin Co., Special Devices Div., 76 Ninth Ave., New York 11, N. Y.
Avion Instrument Corp., Paramus, N. J.
Berkeley Scientific Div. of Beckman Instruments, 2200 Wright Ave., Richmond, Calif.
Bristol Co., The, Waterbury 20, Conn.
Cinema-Television Ltd., Worsley Bridge Rd., London, S. E. 26, England
Electrodyne Co., 32 Oliver St., Boston, Mass.
Electro-Mechanical Research, Inc., 64 Main St., Ridgefield, Conn.
El-Tronics, Inc., 2649 N. Howard St., Philadelphia 33, Pa.
Emerson & Cuming Co., 126 Massachusetts Ave., Boston, Mass.
Fielden Instrument Division, Robertshaw-Fulton Controls Co., 2920 N. 4th St., Philadelphia 33, Pa.
Ford Instrument Co., 31-10 Thomson Ave., Long Island City, N. Y.
HAMMARLUND MFG. CO., 460 W. 34th St., New York 1, N. Y. ADV. PG. 113
Interelectronics Corp., 2432 Grand Concourse, New York 58, N. Y.
Lenkurt Electric Co., 1113 County Road, San Carlos, Calif.
Manning, Maxwell & Moore, Inc., Stratford, Conn.
Melpar Inc., 452 Swann Ave., Alexander, Va.
Nuclear Specialty Co., P. O. Box 455, Center Moriches, N. Y.
Pacific Division, Bendix Aviation Corp., 11600 Sherman Way, North Hollywood, Calif.
Raytheon Mfg. Co., Equipment Sales Div., Waltham 54, Mass.
Resdel Engineering, 2351 Riverside Drive, Los Angeles 39, Calif.
Rosen Engineering Products, Inc., Raymond, 32nd & Walnut St., Philadelphia 4, Pa.
Square Root Mfg. Corp., 391 Saw Mill River Rd., Yonkers, N. Y.
Streeter-Amet Co., 4101 Ravenswood Ave., Chicago 13, Ill.
Westinghouse Electric Corp., P. O. Box 868, Pittsburgh 30, Pa.

TELETHERAPY UNITS

ATOMIC ENERGY OF CANADA, LTD., Commercial Products Div., P. O. Box 93, Ottawa, Ontario, Canada. ADV. PG. 18
GENERAL ELECTRIC CO., Apparatus Sales Div., Schenectady 5, N. Y. ADV. PGS. 2–5
NUCLEAR RESEARCH CORP., 2563 Grays Ferry Ave., Philadelphia 46, Pa. ADV. PG. 97
Radium Chemical Co., 161 E. 42nd St., New York 17, N. Y.
Square Root Mfg. Corp., 391 Saw Mill River Rd., Yonkers, N. Y.
TRACERLAB, INC., 130 High St., Boston 10, Mass. ADV. PG. 24
Western Radiation Lab., 1107 W. 24th St., Los Angeles 27, Calif.

TELEVISION SYSTEMS—Industrial

Cinema-Television Ltd., Worsley Bridge Rd., London, S. E., 26, England
Douglas Radio Labs., 176 Norfolk Ave., Boston 19, Mass.
DuMont Labs., Inc., Allen B., Instrument Div., 1000 Main Ave., Clifton, N. J.
Electric & Musical Industries Ltd., Hayes, Middlesex, England
Falk & Co., Ltd., M., 5 Victoria St., London, S. W. 1, England
General Precision Laboratory, Inc., Pleasantville, N. Y.
Interelectronics Corp., 2432 Grand Concourse, New York 58, N. Y.
Marconi Instruments, Ltd., 23–25 Beaver St., New York 4, N. Y.
RADIO CORP. OF AMERICA, RCA VICTOR DIV., ENGINEERING PRODUCTS DEPT., Front & Cooper Sts., Camden, N. J. ADV. PG. 13
Square Root Mfg. Corp., 391 Saw Mill River Rd., Yonkers, N. Y.
Telotronics Laboratory, Inc., Kinkel St., Westbury, N. Y.

TERMINAL BOARDS

CAMBRIDGE THERMIONIC CORP., 445 Concord Ave., Cambridge 38, Mass. ADV. PG. 22
Cinch Mfg. Corp., 1026 S. Homan Ave., Chicago 24, Ill.
Continental Connector Corp., 30-30 Northern Blvd., Long Island City, N. Y.
DeJur-Amsco Corp., 45-01 Northern Blvd., Long Island City 1, N. Y.
Ehy, Inc., Hugh H., 4700 Stenton Ave., Philadelphia 44, Pa.
Electronic Mechanics Inc., 70 Clifton Blvd., Clifton, N. J.
GENERAL ELECTRIC CO., Apparatus Sales Div., Schenectady 5, N. Y. ADV. PGS. 2–5
Highland Engineering Co., Main St. & Urban Ave., Westbury, N. Y.
Jewil Electronics, Inc., 7945 Germantown Ave., Philadelphia 18, Pa.
Keystone Electronics Corp., 423 Broome St., New York 12, N. Y.
Methode Mfg. Corp., 2021 W. Churchill St., Chicago 47, Ill.
Precision Metal Products Co. of Malden, 41 Elm St., Stoneham 80, Mass.
Ucinite Co. Division, United-Carr Fastener Corp., 459 Watertown St., Newtonville, Mass.
U. S. GASKET CO., 602 N. 10th St., Camden, N. J. ADV. PG. 135

TERMINALS

Aircraft Marine Products, Inc., 2100 Paxton St., Harrisburg 10, Pa.
CAMBRIDGE THERMIONIC CORP., 445 Concord Ave., Cambridge 38, Mass. ADV. PG. 22
Cannon Electric Co., 3209 Humboldt St., Los Angeles 31, Calif.
Cinch Mfg. Corp., 1026 S. Homan Ave., Chicago 24, Ill.
Citation Products Co., 233 E. 146th St., New York 51, N. Y.
Continental Connector Corp., 30-30 Northern Blvd., Long Island City, N. Y.
DeJur-Amsco Corp., 45-01 Northern Blvd., Long Island City 1, N. Y.
Federal Screw Products Inc., 224 W. Huron St., Chicago 10, Ill.
GARDE MFG. CO., 588 Eddy St., Providence 3, R. I. ADV. PG. 98
General Radio Co., 275 Massachusetts Ave., Cambridge 39, Mass.
Hermetic Seal Products Co., 29-37 South 6th St., Newark 7, N. J.
Insuline Corp. of America, 36-02 35th Ave., Long Island City, N. Y.
Johnson Co., E. F., Waseca, Minn.
Keystone Electronics Corp., 423 Broome St., New York 12, N. Y.
Lundey Associates, 694 Main St., Waltham 54, Mass.
Methode Mfg. Corp., 2021 W. Churchill St., Chicago 47, Ill.
National Co., Inc., 61 Sherman St., Malden 48, Mass.
Neo-Sil Corp., 26 Cornelison Ave., Jersey City 4, N. J.
Patton-MacGuyer Co., 17 Virginia Ave., Providence 5, R. I.
Precision Metal Products Co. of Malden, 41 Elm St., Stoneham 80, Mass.
Raytheon Mfg. Co., Equipment Sales Div., Waltham 54, Mass.
Shellcross Mfg. Co., 10 Jackson Ave., Collingdale, Pa.
Sherman Mfg. Co., H. B., 22 Barney St., Battle Creek, Mich.
STUPAKOFF CERAMIC & MFG. CO., Latrobe, Pa. ADV. PG. 131
Superior Electric Co., 83 Laurel St., Bristol, Conn.
United-Carr Fastener Corp., Cambridge 42, Mass.
Westinghouse Electric Corp., P. O. Box 868, Pittsburgh 30, Pa.

TESTERS—Colorimetric Carbon Monoxide

MINE SAFETY APPLIANCES CO., 201 N. Braddock Ave., Pittsburgh 21, Pa. ADV. PG. 130
Phoenix Precision Instrument Co., 3803-05 N. 5th St., Philadelphia, Pa.

TESTERS—Hardness

American Optical Co., Instrument Div., Buffalo 15, N. Y.
Eberbach Corporation, Ann Arbor, Mich.
Ferner Co., R. Y., 110 Pleasant St., Malden, Mass.
Magnaflux Corp., 5900 Northwest Highway, Chicago 31, Ill.
Precision Apparatus Co., Inc., 92-27 Horace Harding Blvd., Elmhurst, N. Y.
Rubicon Co., Ridge Ave. at 35th St., Philadelphia 32, Pa.
U. S. Gauge Div., American Machine & Metals, Inc., Sellersville, Pa.
Weltronic Co., 19500 W. Eight Mile Rd., Detroit 19, Mich.

TESTERS—Tube & Multimeter

American Chronoscope Corp., 316 W. First St., Mt. Vernon, N. Y.
Douglas Radio Labs., 176 Norfolk Ave., Boston 19, Mass.
Electronic Instrument Co., Inc., 276 Newport St., Brooklyn 12, N. Y.
Electronic Measurements Co., Inc., Lewis St. & Maple Ave., Eatontown, N. J.
General Electric Co., Electronics Div., Electronics Park, Syracuse, N. Y.
Mullard Overseas Ltd., Century House, Shaftesbury Ave., London W. C. 2, England
Metropolitan Electronics & Instruments Co., 106 Fifth Ave., New York 11, N. Y.
Oak Ridge Products Mfg. Div., Video Television, Inc., 37-01 Vernon Blvd., Long Island City 1, N. Y.
Radio City Products Co., Inc., 152 W. 25th St., New York 1, N. Y.
RADIO CORP. OF AMERICA, TUBE DEPT., Harrison, N. J. ADV. PG. 93
Rawson Electrical Instrument Co., 114 Potter St., Cambridge 42, Mass.
Simpson Electric Co., Div. of American Gage & Machine Co., 5208 W. Kinzie St., Chicago 44, Ill.
Square Root Mfg. Corp., 391 Saw Mill River Rd., Yonkers, N. Y.
Sylvania Electric Products, Inc., 1740 Broadway, New York 19, N. Y.
Telectro Industries Corp., 35-18 37th St., Long Island City 1, N. Y.
Triplett Electrical Instrument Co., 286 Harmon Rd., Bluffton, Ohio
WESTON ELECTRICAL INSTRUMENT CORP., 614 Frelinghuysen Ave., Newark 5, N. J. ADV. PG. 102

TESTERS—Vacuum

Central Scientific Co., 1700 Irving Park Rd., Chicago 13, Ill.
Consolidated Engineering Corp., 300 N. Sierra Madre Villa, Pasadena 8, Calif.
Daylight Vacuum Products Co., 5207 N. Milwaukee Ave., Chicago 30, Ill.
DISTILLATION PRODUCTS INDUSTRIES, A Division of Eastman Kodak Co., Rochester 3, N. Y. ADV. PG. 91
Douglas Radio Labs., 176 Norfolk Ave., Boston 19, Mass.
Electronic Instrument Co., Inc., 276 Newport St., Brooklyn 12, N. Y.
Eisler Engineering Co., 760 S. 13th St., Newark 3, N. J.
Manning, Maxwell & Moore, Inc., Stratford, Conn.
Metropolitan Electronics & Instruments Co., 106 Fifth Ave., New York 11, N. Y.
OPTICAL FILM ENGINEERING CO., 2731-37 N. 6th St., Philadelphia 33, Pa. ADV. PG. 106
Process & Instruments, 60 Greenpoint Ave., Brooklyn 22, N. Y.
RADIO CORP. OF AMERICA, RCA VICTOR DIV., ENGINEERING PRODUCTS DEPT., Front & Cooper Sts., Camden, N. J. ADV. PG. 13
Sun Electric Corp., 6323 Avondale Ave., Chicago 31, Ill.
Vacuum-Electronic Engineering Co., 86 Denton Ave., New Hyde Park, N. Y.
Welch Scientific Co., W. M., 1515 Sedgwick St., Chicago 10, Ill.
Whittington Pump & Engineering Corp., 1126 Prospect St., Indianapolis 3, Ind.

TESTERS—Voltage

Allied Radio Corp., 833 W. Jackson Blvd., Chicago 7, Ill.
Bright Star Battery Co., 200 Crooks Ave., Clifton, N. J.
Cole Instrument Co., 1320 S. Grand Ave., Los Angeles 15, Calif.
Douglas Radio Labs., 176 Norfolk Ave., Boston 19, Mass.
Electro-Mec Laboratory, 19 Murray St., New York 7, N. Y.
Electronic Instrument Co., Inc., 276 Newport St., Brooklyn 12, N. Y.
Freed Transformer Co., Inc., 1736 Weirfield St., Brooklyn 27, N. Y.
GENERAL ELECTRIC CO., Apparatus Sales Div., Schenectady 5, N. Y. ADV. PGS. 2–5
General Precision Laboratory, Inc., Pleasantville, N. Y.
Industrial Devices, Inc., 22 State Rd., Edgewater, N. J.
Instrument Laboratories, 315 W. Walton Place, Chicago, Ill.
International Instruments, Inc., P. O. Box 2954, New Haven 15, Conn.
Leland Instruments Ltd., 22-23 Millbank, London, S. W. 1, England
Marion Electrical Instrument Co., 402 Canal St., Manchester, N. H.
Martindale Electric Co., 1375 Hird Ave., Cleveland 7, Ohio
Measurement Engineering Ltd., Arapriar, Ontario, Canada
Mercury Electronic Co., Box 450, Red Bank, N. J.
Metropolitan Electronics & Instruments Co., 106 Fifth Ave., New York 11, N. Y.
Network Mfg. Corp., 213 W. 5th St., Bayonne, N. J.

Radio City Products Co., Inc., 152 W. 25th St., New York 1, N. Y.
Simpson Electric Co., Div. of American Gage & Machine Co., 5208 W. Kinzie St., Chicago 44, Ill.
Square Root Mfg. Corp., 391 Saw Mill River Rd., Yonkers, N. Y.
Sticht, Inc., Herman H., 27 Park Place, New York 7, N. Y.
Sun Electric Corp., 6323 Avondale Ave., Chicago 31, Ill.
Sylvania Electric Products, Inc., 1740 Broadway, New York 19, N. Y.
Telectro Industries Corp., 35-18 37th St., Long Island City 1, N. Y.
Triplett Electrical Instrument Co., 286 Harmon Rd., Bluffton, Ohio
U. S. Gauge Div., American Machine & Metals, Inc., Sellersville, Pa.
Welch Scientific Co., W. M., 1515 Sedgwick St., Chicago 10, Ill.
Western Sound & Electric Labs., Inc., 805 S. Fifth St., Milwaukee 4, Wis.
Westinghouse Electric Corp., P. O. Box 868, Pittsburgh 30, Pa.
WESTON ELECTRICAL INSTRUMENT CORP., 614 Frelinghuysen Ave., Newark 5, N. J. ADV. PG. 102

THERMISTORS

Breeze Corps., Inc., 41 S. Sixth St., Newark 7, N. J.
Carbolloy Dept. of General Electric Co., 11139 E. Eight Mile Blvd., Detroit 32, Mich.
Friez Instrument Div. of Bendix Aviation Corp., 1454 Taylor Ave., Baltimore 4, Md.
General Radio Co., 275 Massachusetts Ave., Cambridge 39, Mass.
Micro-Circuits Co., New Buffalo, Mich.
Sperry Gyroscope Co., Great Neck, N. Y.
STUPAKOFF CERAMIC & MFG. CO., Latrobe, Pa. ADV. PG. 131
VICTORY ENGINEERING CORP., Springfield Rd., Union, N. J. ADV. PG. 123

THERMOCOUPLES

Allied Radio Corp., 833 W. Jackson Blvd., Chicago 7, Ill.
AMERICAN PHENOLIC CORP., 1830 S. 54th Ave., Chicago 50, Ill. ADV. PG. 100
American Platinum Works, N. J. R. R. Ave. at Oliver St., Newark, N. J.
American Thermo Electric Co., 198-11 Hollis Ave., Hollis 12, N. Y.
Assembly Products, Inc., Chagrin Falls 6, Ohio
Bishop & Co., J., Malvern, Pa.
Bristol Co., The, Waterbury 20, Conn.
Cole Instrument Co., 1320 S. Grand Ave., Los Angeles 15, Calif.
Dallons Labs., 5066 Santa Monica Blvd., Los Angeles, Calif.
Electric Hotpack Co., Inc., 5035 Cottman Ave., Philadelphia, Pa.
Farrand Optical Co., Inc., Bronx Blvd. at E. 238th St., New York 70, N. Y.
Foxboro Co., 38 Neponset Ave., Foxboro, Mass.
Fredericks Co., George E., Bethayres, Pa.
GENERAL ELECTRIC CO., Apparatus Sales Div., Schenectady 5, N. Y. ADV. PGS. 2-5
Hastings Instrument Co., Super Highway at Pine Ave., Hampton, Va.
Industrial Controls, Inc., 525 N. Noble St., Chicago 22, Ill.
Leeds & Northrup Co., 4970 Stenton Ave., Philadelphia 44, Pa.
Liston-Becker Instrument Co., Inc., 20 Beckley Ave., Stamford, Conn.
Minneapolis-Honeywell Regulator Co., 2753 Fourth Ave. S., Minneapolis, Minn.
MINNEAPOLIS-HONEYWELL REGULATOR CO., Wayne & Roberts Aves., Philadelphia 44, Pa. ADV. PG. 29
Perkin-Elmer Corp., Norwalk, Conn.
Pyrometer Instrument Co., Inc., Bergenfield, N. J.
Radiation Counter Labs., Inc., 1844 W. 21st St., Chicago 8, Ill.
Rawson Electrical Instrument Co., 114 Potter St., Cambridge 42, Mass.
Richards Co., Inc., Arklay S., 12 Winchester St., Newton Highlands 61, Mass.
Sensitive Research Instrument Corp., 9 Elm Ave., Mt. Vernon, N. Y.
Square Root Mfg. Corp., 391 Saw Mill River Rd., Yonkers, N. Y.
Taco West Corp., 525 N. Noble St., Chicago 22, Ill.
Thwing-Albert Instrument Co., Penn St. & Pulaski Ave., Philadelphia 44, Pa.
Western Gold & Platinum Works, 589 Bryant St., San Francisco, Calif.
WESTON ELECTRICAL INSTRUMENT CORP., 614 Frelinghuysen Ave., Newark 5, N. J. ADV. PG. 102
Wheelco Instruments Co., 847 W. Harrison St., Chicago 7, Ill.
Winslow Co., Inc., 9 Liberty St., Newark, N. J.

THERMOMETERS—Laboratory

American Instrument Co., Inc., 8030 Georgia Ave., Silver Spring, Md.
Elmer & Amend Div. of Fisher Scientific Co., 635 Greenwich St., New York, N. Y.
Fisher Scientific Co., 709 Forbes Ave., Pittsburgh 19, Pa.
Jasonols Chemical Corp., 1085 Myrtle Ave., Brooklyn 6, N. Y.
Kahl Scientific Instrument Corp., Box 1166, El Cajon, Calif.
Manning, Maxwell & Moore, Inc., Stratford, Conn.
Miller & Weber, Inc., 71-14 Myrtle Ave., Glendale 27, N. Y.
Mueller Instrument Co., 132nd St. & 89th Ave., Richmond Hill 18, N. Y.
Nurnberg Thermometer Co., Inc., 124 Livingston St., Brooklyn 2, N. Y.
Rushfel Co., Inc., 107-20 101st Ave., Richmond Hill, N. Y.
Scientific Glass Apparatus Co., Inc., 100 Lakewood Terrace, Bloomfield, N. J.
Special Glass Products Co., 2 W. 33rd St., New York, N. Y.
Taylor Instrument Companies, 95 Ames St., Rochester, N. Y.
Thwing-Albert Instrument Co., Penn St. & Pulaski Ave., Philadelphia 44, Pa.
Trans-Sonics, Inc., Bedford Airport, Bedford, Mass.
Webster Thermometer Corp., Martinique Bldg., 49 W. 32nd St., New York 1, N. Y.
WESTON ELECTRICAL INSTRUMENT CORP., 614 Frelinghuysen Ave., Newark 5, N. J. ADV. PG. 102
Yonkers Laboratory Supply Co., 70 Palisade Ave., Yonkers 2, N. Y.

TILE—Asphalt

Armstrong Cork Co., 1010 Concord St., Lancaster, Pa.
Beck & Sons, Inc., 355 E. 20th St., New York 3, N. Y.
Flintkote Co., 30 Rockefeller Plaza, New York 30, N. Y.
Hachmeister, Inc., P. O. Box 357, Pittsburgh 30, Pa.
Johns-Manville, 22 E. 40th St., New York 16, N. Y.
Mastic Tile Corp. of America, Newburgh, N. Y.

TILE—Ceramic

See Flooring, Acid-proof.

TILE—Plastic

Hachmeister, Inc., P. O. Box 357, Pittsburgh 30, Pa.
Mastic Tile Corp. of America, Newburgh, N. Y.
U. S. GASKET CO., 602 N. 10 St., Camden, N. J. ADV. PG. 135

TILE—Rubber

Armstrong Cork Co., 1010 Concord St., Lancaster, Pa.
Beck & Sons, Inc., 355 E. 20th St., New York 3, N. Y.
Goodyear Tire & Rubber Co., Akron, Ohio

TIMERS—Automatic Reset

Allen-Bradley Co., 136 W. Greenfield Ave., Milwaukee 4, Wis.
Automatic Temperature Control Co., Inc., 5206 Pulaski Ave., Philadelphia 44, Pa.
BAR-RAY PRODUCTS, INC., 209 25th St., Brooklyn 32, N. Y. ADV. PG. 112
Bristol Co., The, Waterbury 20, Conn.
Cinema Television Ltd., Worsley Bridge Rd., London, S. E. 26, England
Colloid Equipment Co., Inc., 50 Church St., New York 7, N. Y.
Cramer Co., Inc., R. W., Box 13, Centerbrook, Conn.
Douglas Radio Labs., 176 Norfolk Ave., Boston 19, Mass.
Electric Hotpack Co., Inc., 5035 Cottman Ave., Philadelphia, Pa.
El-Tronics, Inc., 2649 N. Howard St., Philadelphia 33, Pa.
Ford Instrument Co., 31-10 Thomson Ave., Long Island City, N. Y.
Gale Dorothea Mechanisms, Inc., 81-01 Broadway, Elmhurst, N. Y.
Gaveco Labs., Inc., 2 East End Ave., New York 21, N. Y.
General Controls Co., Glendale 1, Calif.
GENERAL ELECTRIC CO., Apparatus Sales Div., Schenectady 5, N. Y. ADV. PGS. 2-5
Guardian Electric Co., 1625 W. Walnut St., Chicago 12, Ill.
Haydon Mfg. Co., Inc., 584 Elm St., Torrington, Conn.
Liebel-Flarsheim Co., The, Cincinnati 15, Ohio
Lumenite Electric Co., 407 S. Dearborn St., Chicago 5, Ill.
Paragon Electric Company, Two Rivers, Wisconsin
Partlow Corp., The, 2 Campion Rd., New Hartford, N. Y.
Phipps & Bird, Inc., 303 S. 6th St., Richmond 5, Va.
Photoswitch, Inc., 77 Broadway, Cambridge, Mass.
RADIOACTIVE PRODUCTS, INC., 443 W. Congress St., Detroit, Mich. ADV. PG. 8
Radioisotope Application Co., 1843 University Ave., Berkeley 3, Calif.
Scientific Services, Inc., 1417 Solano Ave., Albany, Calif.
Tech Laboratories, Inc., Bergen & Edsall Blvds., Palisades Park, N. J.
Telectro Industries Corp., 35-18 37th St., Long Island City 1, N. Y.
TRACERLAB, INC., 130 High St., Boston 10, Mass. ADV. PG. 24
Weltronic Co., 19500 W. Eight Mile Rd., Detroit 19, Mich.
Westinghouse Electric Corp., P. O. Box 868, Pittsburgh 30, Pa.
Wilson & Co., G. C., 2 N. Passaic Ave., Chatham, N. J.
Yonkers Laboratory Supply Co., Palisade Ave., Yonkers 2, N. Y.

TIMERS—Electric

Allen-Bradley Co., 136 W. Greenfield Ave., Milwaukee 4, Wis.
Atomlab, Inc., 439 Fifth Ave., New York 17, N. Y.
Automatic Temperature Control Co., Inc., 5206 Pulaski Ave., Philadelphia 44, Pa.
BAR-RAY PRODUCTS, INC., 209 25th St., Brooklyn 32, N. Y. ADV. PG. 112
Bristol Co., The, Waterbury 20, Conn.
Central Scientific Co., 1700 Irving Park Rd., Chicago 13, Ill.
Cinema-Television Ltd., Worsley Bridge Rd., London S. E. 26, England
Clark Controller Co., 1146 E. 152nd St., Cleveland 10, Ohio
Colloid Equipment Co., Inc., 50 Church St., New York 7, N. Y.
Carol Designs Div., Henry G. Deitz Co., 12-16 Astoria Blvd., Long Island City 2, N. Y.
Cramer Co., Inc., R. W., Box 13, Centerbrook, Conn.
Cutler-Hammer Inc., 412 N. 12th St., Milwaukee 1, Wis.
Doolcam Corp., 56 Elmwood St., Newton, Mass.
Electric Hotpack Co., Inc., 5035 Cottman Ave., Philadelphia, Pa.
Elster Engineering Co., 760 S. 13th St., Newark 3, N. J.
Ford Instrument Co., 31-10 Thomson Ave., Long Island City, N. Y.
Gale Dorothea Mechanisms, Inc., 81-01 Broadway, Elmhurst, N. Y.
General Control Company, 1200 Soldiers Field Rd., Boston 34, Mass.
General Controls Co., Glendale, Calif.
GENERAL ELECTRIC CO., Apparatus Sales Div., Schenectady 5, N. Y. ADV. PGS. 2-5
Gorrell & Gorrell, Haworth, N. J.
Guardian Electric Co., 1625 W. Walnut St., Chicago 12, Ill.
Haydon Mfg. Co., Inc., 584 Elm St., Torrington, Conn.
Liebel-Flarsheim Co., The, Cincinnati 15, Ohio
Lumenite Electric Co., 407 S. Dearborn St., Chicago 5, Ill.
Mallory & Co., Inc., P. R., 3029 E. Washington St., Indianapolis 6, Ind.
Minneapolis-Honeywell Regulator Co., 2753 Fourth Ave. S., Minneapolis, Minn.
NUCLEAR INSTRUMENT & CHEMICAL CORP., 223 W. Erie St., Chicago 10, Ill. ADV. PG. Back Cover
Pacific Division, Bendix Aviation Corp., 11600 Sherman Way, North Hollywood, Calif.
Paragon Electric Co., Two Rivers, Wisconsin
Phipps & Bird, Inc., 303 S. 6th St., Richmond 5, Va.
Picker X-Ray Corp., 25 S. Broadway, White Plains, N. Y.
Precision Scientific Co., 3737 W. Cortland St., Chicago 47, Ill.
RADIOACTIVE PRODUCTS, INC., 443 W. Congress St., Detroit, Mich. ADV. PG. 8
Radioisotope Application Co., 1843 University Ave., Berkeley 3, Calif.
Resdel Engineering, 2351 Riverside Drive, Los Angeles 39, Calif.
Rhodes Inc., M. H. 30 Bartholomew Ave., Hartford, Conn.
Sangamo Electric Co., Springfield, Ill.
Scientific Service, Inc., 1417 Solano Ave., Albany, Calif.
Standard Electric Time Co., 89 Logan St., Springfield, Mass.
Struthers-Dunn, Inc., 150 N. 13th St., Philadelphia 7, Pa.
Telectro Industries Corp., 35-18 37th St., Long Island City 1, N. Y.
Tork Clock Co., Inc., Mount Vernon, N. Y.
TRACERLAB, INC., 130 High St., Boston 10, Mass. ADV. PG. 24

Universal X-Ray Products, Inc., 1140 N. Western Ave., Chicago 22, Ill.
Weltronic Co., 19500 W. Eight Mile Rd., Detroit 19, Mich.
Westinghouse Electric Corp., P. O. Box 868, Pittsburgh 30, Pa.
Whittington Pump & Engineering Corp., 1126 Prospect St., Indianapolis 3, Ind.
Yonkers Laboratory Supply Co., 70 Palisade Ave., Yonkers 2, N. Y.

TIMERS—Electronic

Airmec Laboratories, Ltd., High Wycombe, Buckinghamshire, England
Allen-Bradley Co., 136 W. Greenfield Ave., Milwaukee 4, Wis.
American Chronoscope Corp., 316 W. First St., Mount Vernon, N. Y.
American Electronic Laboratories, Inc., 641 Arch St., Philadelphia 6, Pa.
Atomlab, Inc., 489 Fifth Ave., New York 17, N. Y.
Automatic Temperature Control Co., Inc., 5206 Pulaski Ave., Philadelphia 44, Pa.
Baldwin Instrument Co., Ltd., Brooklands Works, Dartford, Kent, England
Berkeley Scientific Div. of Beckman Instruments, 2200 Wright Ave., Richmond, Calif.
Bristol Co., The, Waterbury 20, Conn.
Cinema-Television Ltd., Worsley Bridge Rd., London, S. E. 26, England
Clark Controller Co., 1146 E. 152nd St., Cleveland 10, Ohio
COLE, LTD., E. K., Electronics Div., Malmesbury, Wiltshire, England. ADV. PG. 28
Colloid Equipment Co., Inc., 50 Church St., New York 7, N. Y.
Coral Designs Div., Henry G. Deitz Co., 12-16 Astoria Blvd., Long Island City 2, N. Y.
Cutler-Hammer, Inc., 412 N. 12th St., Milwaukee 1, Wis.
Detectron Co., 5631 Cahuenga Blvd., North Hollywood, Calif.
Eisler Engineering Co., 760 S. 13th St., Newark 3, N. J.
Electric Hotpack Co., Inc., 5035 Cottman Ave., Philadelphia, Pa.
Electro-Physics Co., 287 Broadway, New York 7, N. Y.
Electrodyne Co., 32 Oliver St., Boston, Mass.
Electronic Control Corp., 1573 E. Forest St., Detroit 7, Mich.
El-Tronics, Inc., 2649 N. Howard St., Philadelphia 33, Pa.
Ford Instrument Co., 31-10 Thomson Ave., Long Island City, N. Y.
General Control Company, 1200 Soldiers Field Rd., Boston 34, Mass.
Guardian Electric Co., 1625 W. Walnut St., Chicago 12, Ill.
Hewlett-Packard Co., 395 Page Mill Rd., Palo Alto, Calif.
Industrial Science Associates, 542 Fifth Ave., New York 19, N. Y.
Leland Instruments Ltd., 22-23 Millbank, London, S. W. 1, England
Lumenite Electric Co., 407 S. Dearborn St., Chicago 5, Ill.
MICHEL MFG. CO., 227 N. Water St., Milwaukee 2, Wis. ADV. PG. 134
Moulic Specialties Co., 1005 W. Washington St., Bloomington, Ill.
Peschel Electronics, Inc., 13 Garden St., New Rochelle, N. Y.
Phipps & Bird, Inc., 303 S. 6th St., Richmond 5, Va.
Photobell Company, 116 Nassau St., New York 7, N. Y.
Photoswitch, Inc., 77 Broadway, Cambridge, Mass.
Photovolt Corp., 95 Madison Ave., New York 16, N. Y.
Picker X-Ray Corp., 25 S. Broadway, White Plains, N. Y.
Potter Instrument Co., 115 Cutter Mill Rd., Great Neck, N. Y.
RADIATION INSTRUMENT DEVELOPMENT LABS., 2337 W. 67th St., Chicago 36, Ill. ADV. PG. Inside Back Cover
RADIO CORP. OF AMERICA, RCA VICTOR DIV., ENGINEERING PRODUCTS DEPT., Front & Cooper Sts., Camden, N. J. ADV. PG. 13
Raytheon Mfg. Co., Equipment Sales Div., Waltham 54, Mass.
Ripley Co., Inc., 22 W. First St., Mt. Vernon, N. Y.
Rutherford Electronics Corp., 3707 S. Robertson Blvd., Culver City, Calif.
Sauare Root Mfg. Corp., 391 Saw Mill River Rd., Yonkers, N. Y.
Standard Electric Time Co., 89 Logan St., Springfield, Mass.
Standard Electronics Research Corp., 2 East End Ave., New York 21, N. Y.
Sticht, Inc., Herman H., 27 Park Place, New York 7, N. Y.
Technical Service Corp., 3116 Michigan Drive, Louisville 5, Ky.
Telechrome, Inc., 88 Merrick Road, Amityville, N. Y.
Telectro Industries Corp., 35-18 37th St., Long Island City 1, N. Y.
Vectron, Inc., 400 Main St., Waltham 54, Mass.
Walkirt Co., 145 W. Hazel, Inglewood, Calif.
Weltronic Co., 19500 W. Eight Mile Rd., Detroit 19, Mich.
Whittington Pump & Engineering Corp., 1126 Prospect St., Indianapolis 3, Ind.
Wilson & Co., G. C., 2 N. Passaic Ave., Chatham, N. J.

TIMERS—Precision

American Chronoscope Corp., 316 W. First St., Mount Vernon, N. Y.
Austin Co., Special Devices Div., 76 Ninth Ave., New York 11, N. Y.
Automatic Temperature Control Co., Inc., 5206 Pulaski Ave., Philadelphia 44, Pa.
Borg Corp., George W., Borg Equipment Div., Janesville, Wis.
Bristol Co., The, Waterbury 20, Conn.
Cinema-Television Ltd., Worsley Bridge Rd., London, S. E. 26, England
Colloid Equipment Co., Inc., 50 Church St., New York 7, N. Y.
Cramer Co., Inc., R. W., Box 13, Centerbrook, Conn.
Cutler-Hammer Inc., 412 N. 12th St., Milwaukee 1, Wis.
Detectron Co., 5631 Cahuenga Blvd., North Hollywood, Calif.
Ford Instrument Co., 31-10 Thomson Ave., Long Island City, N. Y.
Gale-Dorothea Mechanisms, Inc., 81-01 Broadway, Elmhurst, N. Y.
GENERAL ELECTRIC CO., Apparatus Sales Div., Schenectady 5, N. Y. ADV. PGS. 2-5
Guardian Electric Co., 1625 W. Walnut St., Chicago 12, Ill.
Liebel-Flarsheim Co., The, Cincinnati 15, Ohio
Lumenite Electric Co., 407 S. Dearborn St., Chicago 5, Ill.
Phipps & Bird, Inc., 303 S. 6th St., Richmond 5, Va.
Photoswitch, Inc., 77 Broadway, Cambridge, Mass.
Picker X-Ray Corp., 25 S. Broadway, White Plains, N. Y.
Radioisotope Application Co., 1843 University Ave., Berkeley 3, Calif.
RADIO CORP. OF AMERICA, RCA VICTOR DIV., ENGINEERING PRODUCTS DEPT., Front & Cooper Sts., Camden, N. J. ADV. PG. 13
Rutherford Electronics Corp., 3707 S. Robertson Blvd., Culver City, Calif.
Scientific Service Inc., 1417 Solano Ave., Albany, Calif.
Square Root Mfg. Corp., 391 Saw Mill River Rd., Yonkers, N. Y.
Standard Electric Time Co., 89 Logan St., Springfield, Mass.
Tork Clock Co., Inc., Mount Vernon, N. Y.
TRACERLAB, INC., 130 High St., Boston 10, Mass. ADV. PG. 24
Universal X-Ray Products, Inc., 1140 N. Western Ave., Chicago 22, Ill.
Vectron, Inc., 400 Main St., Waltham 54, Mass.
Weltronic Co., 19500 W. Eight Mile Rd., Detroit 19, Mich.

TIMERS—Printing Interval

Automatic Temperature Control Co., Inc., 5206 Pulaski Ave., Philadelphia 44, Pa.
Berkeley Scientific Div. of Beckman Instruments, 2200 Wright Ave., Richmond, Calif.
Borg Corp., George W., Borg Equipment Div., Janesville, Wis.
Colloid Equipment Co., Inc., 50 Church St., New York 7, N. Y.
Douglas Radio Labs., 176 Norfolk Ave., Boston 19, Mass.
GENERAL ELECTRIC CO., Apparatus Sales Div., Schenectady 5, N. Y. ADV. PGS. 2-5
Lumenite Electric Co., 407 S. Dearborn St., Chicago 5, Ill.
Photovolt Corp., 95 Madison Ave., New York 16, N. Y.
Potter Instrument Co., 115 Cutter Mill Rd., Great Neck, N. Y.
Special Instruments Laboratory, Inc., 1003 Highland Ave., Knoxville, Tenn.
Streeter-Amet Co., 4101 Ravenswood Ave., Chicago 13, Ill.
TRACERLAB, INC., 130 High St., Boston 10, Mass. ADV. PG. 24
Vectron, Inc., 400 Main St., Waltham 54, Mass.
Wilson & Co., G. C., 2 N. Passaic Ave., Chatham, N. J.

TITRATORS

Central Scientific Co., 1700 Irving Park Rd., Chicago 13, Ill.
Consolidated Engineering Corp., 300 N. Sierra Madre Villa, Pasadena 8, Calif.
Fisher Scientific Co., 709 Forbes Ave., Pittsburgh 19, Pa.
Precision Scientific Co., 3737 W. Cortland St., Chicago 47, Ill.
Sargent & Co., E. H., 4647 W. Foster Ave., Chicago 30, Ill.
Scientific Glass Apparatus Co., Inc., 100 Lakewood Terrace, Bloomfield, N. J.
Yonkers Laboratory Supply Co., 70 Palisade Ave., Yonkers 2, N. Y.

TRANSFORMERS—Constant Voltage

Acme Electric Corp., 31 Water St., Cuba, N. Y.
Airdesign Inc., 241 Fairfield Ave., Upper Darby, Pa.
Airpax Products Co., Middle River, Baltimore 20, Md.
Allied Radio Corp., 833 W. Jackson Blvd., Chicago 7, Ill.
Allis-Chalmers Mfg. Co., 935 S. 70th St., Milwaukee 1, Wis.
Atlas Coil Winders, Inc., 392 State St., Stamford, Conn.
Bogue Electric Mfg. Co., 52 Iowa Ave., Paterson 3, N. J.
Clarkstan Corp., 11921 SW Pico Blvd., Los Angeles 64, Calif.
Eisler Engineering Co., 760 S. 13th St., Newark 3, N. J.
Epco Products, Inc., 2500 Atlantic Ave., Brooklyn 7, N. Y.
General Radio Co., 275 Massachusetts Ave., Cambridge 39, Mass.
Halldorson Transformer Co., 4500 N. Ravenswood Ave., Chicago, Ill.
Hevi Duty Electric Co., 4212 W. Highland Blvd., Milwaukee 1, Wis.
Highland Engineering Co., Main St. & Urban Ave., Westbury, N. Y.
Inet, Inc., 8655 S. Main St., Los Angeles 3, Calif.
K-V Transformer Corp., 20 E. Franklin St., Danbury, Conn.
Kenyon Transformer Co., Inc., 840 Barry St., New York 59, N. Y.
Langevin Mfg. Corp., 37 W. 65th St., New York 23, N. Y.
Lavoie Laboratories, Morganville, N. J.
Magnetic Amplifiers, Inc., 632 Tinton Ave., New York 55, N. Y.
Magnetics, Inc., Box 230-A, Butler, Pa.
Raytheon Mfg. Co., Equipment Sales Div., Waltham 54, Mass.
Sola Electric Co., 4633 W. 16th St., Chicago 50, Ill.
Specialties, Inc., Skunks Misery Road, Syosset, N. Y.
Square Root Mfg. Corp., 391 Saw Mill River Rd., Yonkers, N. Y.
Standard Transformer Corp., 3580 N. Elston Ave., Chicago 18, Ill.
Thordarson-Meissner Mfg. Divs., Mt. Carmel, Ill.
United Transformer Co., 150 Varick St., New York 13, N. Y.
Vara Mfg. Co., Inc., Box 638, Garland, Texas
Westinghouse Electric Corp., P. O. Box 868, Pittsburgh 30, Pa.

TRANSFORMERS—Variable

Acme Electric Corp., 31 Water St., Cuba, N. Y.
Allied Radio Corp., 833 W. Jackson Blvd., Chicago 7, Ill.
Allis-Chalmers Mfg. Co., 935 S. 70th St., Milwaukee 1, Wis.
Atlas Coil Winders, Inc., 392 State St., Stamford, Conn.
Bogue Electric Mfg. Co., 52 Iowa Ave., Paterson 3, N. J.
Clarkstan Corp., 11921 SW Pico Blvd., Los Angeles 64, Calif.
Eisler Engineering Co., 760 S. 13th St., Newark 3, N. J.
Epco Products, Inc., 2500 Atlantic Ave., Brooklyn 7, N. Y.
General Radio Co., 275 Massachusetts Ave., Cambridge 39, Mass.
Halldorson Transformer Co., 4500 N. Ravenswood Ave., Chicago, Ill.
Hevi Duty Electric Co., 4212 W. Highland Blvd., Milwaukee 1, Wis.
Highland Engineering Co., Main St. & Urban Ave., Westbury, N. Y.
Inet, Inc., 8655 S. Main St., Los Angeles 3, Calif.
K-V Transformer Corp., 20 E. Franklin St., Danbury, Conn.
Langevin Mfg. Corp., 37 W. 65th St., New York 23, N. Y.
Magnetics, Inc., Box 230-A, Butler, Pa.
Raytheon Mfg. Co., Equipment Sales Div., Waltham 54, Mass.
Sierra Electronic Co., San Carlos, Calif.
SORENSEN & CO., INC., 375 Fairfield Ave., Stamford, Conn. ADV. PG. 125
Specialties, Inc., Skunks Misery Road, Syosset, N. Y.
Square Root Mfg. Corp., 391 Saw Mill River Rd., Yonkers, N. Y.
Standard Transformer Corp., 3580 N. Elston Ave., Chicago 18, Ill.
Superior Electric Co., 83 Laurel St., Bristol, Conn.
Thordarson-Meissner Mfg. Divs., Mt. Carmel, Ill.
United Transformer Co., 150 Varick St., New York 13, N. Y.

TRANSFORMERS—Voltage Regulating

Acme Electric Corp., 31 Water St., Cuba, N. Y.
Airpax Products Co., Middle River, Baltimore 20, Md.
Allied Radio Corp., 833 W. Jackson Blvd., Chicago 7, Ill.
Allis-Chalmers Mfg. Co., 935 S. 70th St., Milwaukee 1, Wis.
Atlas Coil Winders, Inc., 392 State St., Stamford, Conn.
Bogue Electric Mfg. Co., 52 Iowa Ave., Paterson 3, N. J.
Elster Engineering Co., 760 S. 13th St., Newark 3, N. J.
Electronic Transformer Co., Inc., 215 W. 25th St., New York, N. Y.
Forranti Electric, Inc., 30 Rockefeller Plaza, New York 20, N. Y.
General Radio Co., 275 Massachusetts Ave., Cambridge 39, Mass.
Halldorson Transformer Co., 4500 N. Rovenswood Ave., Chicago, Ill.
Heyi Duty Electric Co., 4212 W. Highland Blvd., Milwaukee 1, Wis.
Highland Engineering Co., Main St. & Urban Ave., Westbury, N. Y.
Inet, Inc., 8655 S. Main St., Los Angeles 3, Calif.
K-V Transformer Corp., 20 E. Franklin St., Danbury, Conn.
Langevin Mfg. Corp., 37 W. 65th St., New York 23, N. Y.
Magnetics, Inc., Box 230-A, Butler, Pa.
Raytheon Mfg. Co., Equipment Sales Div., Waltham 54, Mass.
Sola Electric Co., 4633 W. 16th St., Chicago 50, Ill.
Specialties, Inc., Skunks Misery Road, Syosset, N. Y.
Square Root Mfg. Corp., 391 Saw Mill River Rd., Yonkers, N. Y.
Standard Transformer Corp., 3580 N. Elston Ave., Chicago 18, Ill.
Thordarson-Meissner Mfg. Divs., Mt. Carmel, Ill.
Transformer Specialty Co., Bala-Cynwyd, Pa.
United Transformer Co., 150 Varick St., New York 13, N. Y.
WESTON ELECTRICAL INSTRUMENT CORP., 614 Frelinghuysen Ave., Newark 5, N. J. ADV. PG. 102

TUBE FITTINGS

See FITTINGS—Flared Tube

TUBES—Electron

See also DIODES—Germanium
THERMISTORS

(a) Electrometer
(b) Ignitron
(c) Photomultiplier
(d) Power
(e) Receiving
(f) Rectifying
(g) Thyratron
(h) Voltage Regulating
(i) X-Ray

Allied Radio Corp., 833 W. Jackson Blvd., Chicago 7, Ill. a-b-c-d-e-f-g-h-i
Amperex Electronic Corp., 230 Duffy Ave., Hicksville, N. Y. b-d-f-g-h-i
ANTON ELECTRONIC LABS., INC., 1226-38 Flushing Ave., Brooklyn 37, N. Y. c-h. ADV. PG. 136
Bomac Laboratories, Inc., Salem Rd., Beverly, Mass. g
Chatham Electronics Corp., 475 Washington St., Newark 2, N. J. d-e-f-g-h
Cinema Television Ltd., Worsley Bridge Rd., London, S. E. 26, England. c
Clarostat Mfg. Co., Inc., Dover, New Hampshire. h
Daylight Vacuum Products Co., 5207 N. Milwaukee Ave., Chicago 30, Ill. b-c
DuMont Labs., Inc., Allen B., 1000 Main Ave., Clifton, N. J. c-g
Eitel-McCullough, Inc., San Bruno, Calif. d-f
Electric & Musical Industries, Ltd., Hayes, Middlesex, England. c-d-e-f
Electronic Products Co., 111 E. Third St., Mount Vernon, N. Y. h
Electrons, Inc., 127 Sussex Ave., Newark 4, N. J. d-f-g
Federal Telephone & Radio Corp., 100 Kingsland Rd., Clifton, N. J. d-f
General Electric Co., Tube Dept., Schenectady 5, N. Y. a-b-d-e-f-g-h
Heintz & Kaufman Div., The Robert Dollar Co., 947 Broadway, Redwood City, Calif. d-f
HIGH VOLTAGE ENGINEERING CORP., 7 University Rd., Cambridge 38, Mass. i. ADV. PG. 20
Huggins Laboratories, 734 Hamilton Ave., Menlo Park, Calif. e
Hytron Radio & Electronics Co., A Div. of Columbia Broadcasting System, Inc., 100 Endicott St., Danvers, Mass. d-e-f-h
Lewis & Kaufman Inc., P. O. Box 337, Los Gatos, Calif. d-f
Machlett Laboratories, Inc., 1063 Hope St., Springdale, Conn. d-f-g-i
Marconi Instruments Ltd., 23-25 Beaver St., New York 4, N. Y. a
Mullard Overseas Ltd., Century House, Shaftesbury Ave., London W. C. 2, England. a-b-d-e-f-g-h-i
North American Philips Co., Inc., 100 E. 42nd St., New York 17, N. Y. i
Nuclear Development Laboratory, P. O. Box 7034, Kansas City, Mo. h
Nucleonics & Radiological Developments, Ltd., 77 King's Road, London S. W. 3, England. h
Phoenix Precision Instrument Co., 3803-05 N. 5th St., Philadelphia, Pa. c
Picker X-Ray Corp., 25 S. Broadway, White Plains, N. Y. i
RADIO CORP. OF AMERICA, RCA VICTOR DIV., ENGINEERING PRODUCTS DEPT., Camden, N. J. c-d-e-f-g-h. ADV. PG. 13
RADIO CORP. OF AMERICA, TUBE DEPT., Harrison, N. J. b-c-d-e-f-g-h. ADV. PG. 93
Rauland Corp., 4245 N. Knox Ave., Chicago 41, Ill. g
Raytheon Mfg. Co., Equipment Sales Div., Waltham 54, Mass. d-e-f-h
RAYTHEON MFG. CO., SPECIAL TUBE SECTION, 55 Chapel St., Newton 58, Mass. a-d-e-f-g-h. ADV. PG. 14
Red Bank Division, Bendix Aviation Corp., Eatontown, N. J. e-f-h
Sylvania Electric Products, Inc., 1740 Broadway, New York 19, N. Y. d-e-f-g-h
Tung-Sol Electric, Inc., 95 Eighth Ave., Newark 4, N. J. c-e-f
Twentieth Century Electronics, Ltd., Dunbar Works, Dunbar St., West Norwood, London, S. E. 27, England. i
Universal X-Ray Products, Inc., 1140 N. Western Ave., Chicago 22, Ill. i
VICTOREEN INSTRUMENT CO., 3800 Perkins Ave., Cleveland 14, Ohio. a-e-f-h. ADV. PG. Inside Front Cover
Western Radiation Lab., 1107 W. 24th St., Los Angeles 27, Calif. h
Westinghouse Electric Corp., Electronic Tube Div., P. O. Box 284, Elmira, N. Y. b-c-d-e-f-g-h-i
X-Ray Department of General Electric Co., 4855 Electric Ave., Milwaukee 1, Wis. i

TUBING—Glass

Bache & Co., Semon, 636 Greenwich St., New York 14, N. Y.
Corning Glass Works, Corning, N. Y.
Daylight Vacuum Products Co., 5207 N. Milwaukee Ave., Chicago 30, Ill.
Fischer & Porter Co., 50 County Line Rd., Hatboro, Pa.
Hickey Inc., Fred S., 5041 W. Lake St., Chicago 44, Ill.
Fredericks Co., George E., Bethayres, Pa.
KONTES GLASS CO., Spruce St., Vineland, N. J. ADV. PG. 126
Milwaukee Glass Works, Inc., 2338 N. 30th St., Milwaukee, Wis.
Phoenix Precision Instrument Co., 3803-05 North 5th St., Philadelphia, Pa.
Special Glass Products Co., 2 W. 33rd St., New York, N. Y.
Yonkers Laboratory Supply Co., 70 Palisade Ave., Yonkers 2, N. Y.

TUBING—Metal and Alloy

Alloy Tube Division of Carpenter Steel Co., Union, N. J.
Alpha Metals, Inc., P. O. Box 34, 56 Water St., Jersey City, N. J.
Aluminum Co. of America, 801 Gulf Bldg., Pittsburgh, Pa.
American Brass Co., Waterbury 20, Conn.
American Smelting & Refining Co., 120 Broadway, New York 5, N. Y.
Astell & Co., Inc., John B., 90 West Broadway, New York 7, N. Y.
Babcock & Wilcox Co., 161 E. 42nd St., New York 17, N. Y.
Bishop & Co., J., Malvern, Pa.
Bridgeport Brass Co., 30 Grand St., Bridgeport 2, Conn.
Bristol Metal Products Corp., Bristol, Conn.
Carpenter Steel Co., The, Reading, Pa.
Chase Brass & Copper Co., Inc., Waterbury 20, Conn.
Consolidated Siphon Supply Co., Inc., 24 Wooster St., New York, N. Y.
Division Lead Co., 836 W. Kinzie St., Chicago 22, Ill.
Haynes Stellite Co., Div. of Union Carbide & Carbon Corp., Kokomo, Indiana
International Nickel Co., Inc., 67 Wall St., New York 5, N. Y.
Makepeace Co., D. E., Attleboro, Mass.
National Lead Co., 111 Broadway, New York 6, N. Y.
Precision Tube Co., Inc., Lansdale, Pa.
Revere Copper & Brass, Inc., 230 Park Avenue, New York 17, N. Y.
SUPERIOR TUBE CO., 2510 Germantown Ave., Norristown, Pa. ADV. PG. 25
Wirz, Inc., A. H., Chester, Pa.

TUBING—Plastic

Anchor Plastics Co., Inc., 541 Canal St., New York 13, N. Y.
Consolidated Siphon Supply Co., Inc., 24 Wooster St., New York, N. Y.
Continental-Diamond Fibre Co., Newark, Delaware
Fisher Scientific Co., 709 Forbes Ave., Pittsburgh 19, Pa.
General Electric Co., Chemical Div., 1 Plastics Ave., Pittsfield, Mass.
Houghton Laboratories, Inc., 322 Bush St., Olean, N. Y.
Irvington Varnish & Insulator Co., 10 Argyle Terrace, Irvington, N. J.
Keller Products, Inc., Manchester, N. H.
Keystone Electronics Corp., 423 Broome St., New York 13, N. Y.
National Vulcanized Fibre Co., Wilmington 99, Del.
Natvar Corp., 211 Randolph Ave., Woodbridge, N. J.
Pabst Engineering Equipment Co., Inc., Elizabeth, N. J.
Penn Fibre & Specialty Co., 2030 E. Westmoreland St., Philadelphia 34, Pa.
Polymer Corp. of Penna., The, Reading, Pa.
Spaulding Fibre Co., Inc., 310 Wheeler St., Tonawanda, N. Y.
Synthane Corp., River Road, Oaks, Pa.
United Chromium, Inc., 100 E. 42nd St., New York, N. Y.
U. S. GASKET CO., 602 N. 10th St., Camden, N. J. ADV. PG. 135
U. S. Rubber Co., 1230 Avenue of the Americas, New York 20, N. Y.
U. S. Stoneware Co., The, Akron 9, Ohio
Yonkers Laboratory Supply Co., 70 Palisade Ave., Yonkers 2, N. Y.

TUBING—Rubber

American Oxygen Service Corp., 600 Essex St., Harrison, N. J.
Auburn Mfg. Co., 500 Stack St., Middletown, Conn.
Fisher Scientific Co., 709 Forbes Ave., Pittsburgh 19, Pa.
Garlock Packing Co., Palmyra, N. Y.
General Electric Co., Chemical Div., 1 Plastics Ave., Pittsfield, Mass.
Goodyear Tire & Rubber Co., Akron, Ohio
Republic Rubber Division of Lee Rubber & Tire Corp., Youngstown, Ohio
U. S. Rubber Co., 1230 Avenue of the Americas, New York 20, N. Y.
Yonkers Laboratory Supply Co., 70 Palisade Ave., Yonkers 2, N. Y.

TUBING—Seamless

American Brass Co., Waterbury 20, Conn.
Astell & Co., Inc., John B., 90 West Broadway, New York 7, N. Y.
Babcock & Wilcox Co., 161 E. 42nd St., New York 17, N. Y.
Bishop & Co., J., Malvern, Pa.
Bridgeport Brass Co., 30 Grand St., Bridgeport 2, Conn.
Chase Brass & Copper Co., Inc., Waterbury 20, Conn.
International Nickel Co., Inc., 67 Wall St., New York 5, N. Y.
Precision Tube Co., Inc., Lansdale, Pa.
Revere Copper & Brass, Inc., 230 Park Ave., New York 17, N. Y.
SUPERIOR TUBE CO., 2510 Germantown Ave., Norristown, Pa. ADV. PG. 25
Yonkers Laboratory Supply Co., 70 Palisade Ave., Yonkers 2, N. Y.

UTENSILS—Laboratory

Alco Scientific Div. of A. S. Aloe Co., 5655 Kingsbury Blvd., St. Louis 12, Mo.
Consolidated Siphon Supply Co., Inc., 24 Wooster St., New York, N. Y.
Eberbach Corporation, Ann Arbor, Mich.
Elmer & Amend Div. of Fisher Scientific Co., 633 Greenwich St., New York, N. Y.
Fisher Scientific Co., 709 Forbes Ave., Pittsburgh 19, Pa.
Goodrich Co., B. F., Akron, Ohio
Humboldt Mfg. Co., 2814 N. Whipple St., Chicago 47, Ill.
Precision Scientific Co., 3737 W. Cortland St., Chicago 47, Ill.
Welch Scientific Co., W. M., 1515 Sedgwick St., Chicago 10, Ill.
Yonkers Laboratory Supply Co., 70 Palisade Ave., Yonkers 2, N. Y.

VALVES—Acid Proof

General Ceramics & Steatite Corp., 250 Crows Mill Road, Keasbey, N. J.
U. S. Stoneware Co., Akron 9, Ohio

VALVES—Control

Alco Valve Co., 865 Kingsland Ave., St. Louis 5, Mo.
American Oxygen Service Corp., 600 Essex St., Harrison, N. J.

VALVES

Anderson Valve Works, 9th & Adams Ave., Marion, Ind.
ASSOCIATED VALVE & ENGINEERING CO., 1150 W. Marquette Rd., Chicago 21, Ill. ADV. PG. 132
Astell & Co., Inc., John B., 90 West Broadway, New York 7, N. Y.
Automatic Temperature Control Co., Inc., 5206 Pulaski Ave., Philadelphia 44, Pa.
BAR-RAY PRODUCTS, INC., 209 25th St., Brooklyn 32, N. Y. ADV. PG. 112
Bristol Co., The, Waterbury 20, Conn.
Conoflow Corp., 2100 Arch St., Philadelphia 3, Pa.
Daylight Vacuum Products Co., 5207 N. Milwaukee Ave., Chicago 30, Ill.
Denison Engineering Co., 1186 Dublin Rd., Columbus, Ohio
Eclipse Fuel Engineering Co., 705 S. Main St., Rockford, Ill.
Fairbanks Co., The, 393 Lafayette St., New York 3, N. Y.
Ford Instrument Co., 31-10 Thomson Ave., Long Island City, N. Y.
Foxboro Co., 38 Neponset Ave., Foxboro, Mass.
Fulton Sylphon Division, Robertshaw-Fulton Controls Co., Knoxville 4, Tenn.
General Controls Co., Glendale 1, Calif.
General Regulator Corp., 165 Broadway, New York 6, N. Y.
Hammel-Dahl Co., 175 Post Rd., (Warwick) Providence 5, R. I.
Hoppe Engineering Co., 1 High St., Greensboro, Ind.
Imperial Brass Mfg. Co., 1200 W. Harrison St., Chicago 7, Ill.
Johnson Service Co., 507 E. Michigan St., Milwaukee 2, Wis.
Keckley Co., O. C., 400 Madison St., Chicago 6, Ill.
Kinney & Mueller, Inc., North Bergen, N. J.
Lapp Insulator Co., Inc., 31 Gilbert St., LeRoy, N. Y.
Linde Air Products Co., Div. of Union Carbide & Carbon Corp., 30 E. 42nd St., New York 17, N. Y.
Minneapolis-Honeywell Regulator Co., 2753 Fourth Ave. S., Minneapolis, Minn.
MINNEAPOLIS-HONEYWELL REGULATOR CO., Wayne & Roberts Aves., Philadelphia 44, Pa. ADV. PG. 29
Numatics, 106 S. Main St., Milford, Mich.
Pabst Engineering Equipment Co., Inc., Elizabeth, N. J.
Pacific Division, Bendix Aviation Corp., 11600 Sherman Way, North Hollywood, Calif.
Partlow Corp., The, 2 Campion Rd., New Hartford, N. Y.
Powers Regulator Co., 3400 Oakton, Skokie, Ill.
Rockwell Co., W. S., 200 Eliot St., Fairfield, Conn.
Skinner Electric Valve Div., 137 Belden Ave., Norwalk, Conn.
Taylor Instrument Companies, 95 Ames St., Rochester, N. Y.
Vacuum-Electronic Engineering Co., 86 Denton Ave., New Hyde Park, N. Y.
Walworth Co., 60 E. 42nd St., New York 17, N. Y.
Weltronic Co., 19500 W. Eight Mile Rd., Detroit 19, Mich.

VALVES—Vacuum

American Oxygen Service Corp., 600 Essex St., Harrison, N. J.
ASSOCIATED VALVE & ENGINEERING CO., 1150 Marquette Rd., Chicago 21, Ill. ADV. PG. 132
Bristol Co., The, Waterbury 20, Conn.
Conoflow Corp., 2100 Arch St., Philadelphia 3, Pa.
Daylight Vacuum Products Co., 5207 N. Milwaukee Ave., Chicago 30, Ill.
DISTILLATION PRODUCTS INDUSTRIES, A Division of Eastman Kodak Co., Rochester 3, N. Y. ADV. PG. 91
Fulton Sylphon Division, Robertshaw-Fulton Controls Co., Knoxville 4, Tenn.
Hammel-Dahl Co., 175 Post Rd., (Warwick) Providence 5, R. I.
HIGH VOLTAGE ENGINEERING CORP., 7 University Rd., Cambridge 38, Mass. ADV. PG. 20
Hoppe Engineering Co., 1 High St., Greensboro, Ind.
Imperial Brass Mfg. Co., 1200 W. Harrison St., Chicago 7, Ill.
Keckley Co., O. C., 400 W. Madison St., Chicago 6, Ill.
Kinney & Mueller, Inc., North Bergen, N. J.
KINNEY MFG. CO., 3529 Washington St., Boston, Mass. ADV. PG. 95
NATIONAL RESEARCH CORP., 70 Memorial Drive, Cambridge 42, Mass. ADV. PG. 16
OPTICAL FILM ENGINEERING CO., 2731-37 N. 6th St., Philadelphia 33, Pa. ADV. PG. 106
Red Bank Division, Bendix Aviation Corp., Eatontown, N. J.
STOKES MACHINE CO., F. J., Frankford Station P. O., Philadelphia 20, Pa. ADV. PG. 117
Vacuum-Electronic Engineering Co., 86 Denton Ave., New Hyde Park, N. Y.

VENTILATORS

Accurate Sheet Metal & Mfg. Works, 2336-38 Milwaukee Ave., Chicago 47, Ill.
BAR-RAY PRODUCTS, INC., 209 25th St., Brooklyn 32, N. Y. ADV. PG. 112
Century Fan & Ventilator Co., 25 Cedar St., Stamford, Conn.
Hirschman-Pohle Co., Inc., 115 Lent Ave., LeRoy, N. Y.
Ilg Electric Ventilating Co., 2850 N. Crawford Ave., Chicago 41, Ill.
Iona Ventilator Co., Inc., 2829 W. Dauphin St., Philadelphia, Pa.
Jordon & Co., Paul R., E. South & New Jersey, Indianapolis, Ind.
MINE SAFETY APPLIANCES CO., 201 N. Braddock Ave., Pittsburgh 21, Pa. ADV. PG. 130
Pabst Engineering Equipment Co., Inc., Elizabeth, N. J.
Warner Ventilator Co., La Grange, Ind.
Western Engineering & Mfg. Co., 4112 Ocean Park Ave., Venice, Calif.

VOLTMETERS—Electronic

Airmec Laboratories, Ltd., High Wycombe, Buckinghamshire, England
American Chronoscope Corp., 316 W. First St., Mt. Vernon, N. Y.
Audio Instrument Co., 133 W. 14th St., New York 11, N. Y.
Baldwin Instrument Co., Ltd., Brooklands Works, Dartford, Kent, England
Ballantine Laboratories, Inc., Boonton, N. J.
Bristol Co., The, Waterbury 20, Conn.
C. G. S. Laboratories, Inc., 391 Ludlow St., Stamford, Conn.
COLE, LTD., E. K., Electronics Div., Malmesbury, Wiltshire, England. ADV. PG. 28
Daven Co., 191 Central Ave., Newark 4, N. J.
Douglas Radio Labs., 176 Norfolk Ave., Boston 19, Mass.
Electro-Mec Laboratory, 19 Murray St., New York 7, N. Y.
Electronic Instrument Co., Inc., 276 Newport St., Brooklyn 12, N. Y.
Electronic Measurements Co., Inc., Lewis St. & Maple Ave., Eatontown, N. J.
Fluke Engineering Co., John, 1111 W. Nickerson St., Seattle 99, Wash.
Freed Transformer Co., Inc., 1736 Weirfield St., Brooklyn 27, N. Y.
GENERAL ELECTRIC CO., Apparatus Sales Div., Schenectady 5, N. Y. ADV. PGS. 2-5
General Radio Co., 275 Massachusetts Ave., Cambridge 39, Mass.
Heath Co., Benton Harbor, Mich.
Hewlett-Packard Co., 395 Page Mill Rd., Palo Alto, Calif.
Industrial Control Co., Straight Path & Arlington Ave., Wyandanch, N. Y.
Interelectronics Corp., 2432 Grand Concourse, New York 58, N. Y.
Keithley Instruments, 3868 Carnegie Ave., Cleveland, Ohio.
Leland Instruments Ltd., 22-23 Millbank, London, S. W. 1, England
Measurement Engineering Ltd., Arnprior, Ontario, Canada
MEASUREMENTS CORP., Boonton, N. J. ADV. PG. 96
Mercury Electronic Co., Box 450, Red Bank, N. J.
Metropolitan Electronics & Instruments Co., 106 Fifth Ave., New York 11, N. Y.
Phaostron Co., 151 Pasadena Ave., South Pasadena, Calif.
Precision Apparatus Co., Inc., 92-97 Horace Harding Blvd., Elmhurst, N. Y.
Radio City Products Co., Inc., 153 W. 25th St., New York 1, N. Y.
RADIO CORP. OF AMERICA, TUBE DEPT., Harrison, N. J. ADV. PG. 93
SANBORN CO., 39 Osborn St., Cambridge 39, Mass. ADV. PG. 92
Sierra Electronic Corp., San Carlos, Calif.
Simpson Electric Co., Div. of American Gage & Machine Co., 5208 W. Kinzie St., Chicago 44, Ill.
Southwestern Industrial Electronics Co., 2831 Post Oak Rd., P. O. Box 13058, Houston 19, Texas.
Square Root Mfg. Corp., 391 Saw Mill River Rd., Yonkers, N. Y.
Sylvania Electric Products, Inc., 1740 Broadway, New York 19, N. Y.
Telectro Industries Corp., 35-18 37th St., Long Island City 1, N. Y.
Triplett Electrical Instrument Co., 286 Harmon Rd., Bluffton, Ohio
Waveforms, Inc., 333 Sixth Ave., New York 14, N. Y.
Western-Electro-Acoustic Labs., 204 S. Beverly Drive, Beverly Hills, Calif.
Western Radiation Lab., 1107 W. 24th St., Los Angeles 27, Calif.
Western Sound & Electric Labs., Inc., 805 S. Fifth St., Milwaukee 4, Wis.
WESTON ELECTRICAL INSTRUMENT CORP., 614 Frelinghuysen Ave., Newark 5, N. J. ADV. PG. 102

WASHERS—Laboratory Glassware

Aloe Scientific Div. of A. S. Aloe Co., 5655 Kingsbury Blvd., St. Louis 12, Mo.
Bookel & Co., Inc., Wm., 509-519 Vine St., Philadelphia 6, Pa.
Colloid Equipment Co., Inc., 50 Church St., New York 7, N. Y.
Eimer & Amend Div. of Fisher Scientific Co., 635 Greenwich St., New York, N. Y.
Fisher Scientific Co., 709 Forbes Ave., Pittsburgh 19, Pa.
Heinicke Instruments, 2035 Harding St., Hollywood, Fla.
Yonkers Laboratory Supply Co., 70 Palisade Ave., Yonkers 2, N. Y.

WATER CONDITIONERS

Allied Chemical & Dye Corp., Solvay Process Div., 61 Broadway, New York 6, N. Y.
Alrose Chemical Co., Box 1294, Providence, R. I.
BAR-RAY PRODUCTS, INC., 209 25th St., Brooklyn 32, N. Y. ADV. PG. 112
Bogue Electric Mfg. Co., 52 Iowa Ave., Paterson 3, N. J.
Crystal Research Laboratories, Inc., 33 Allyn St., Hartford, Conn.
Illinois Water Treatment Co., 858 Cedar St., Rockford, Ill.
Inflico, Inc., P. O. Box 5033, Tucson, Ariz.
Mathieson Chemical Corp., Mathieson Bldg., Baltimore 3, Md.
Permutit Co., 330 W. 42nd St., New York 36, N. Y.

WAXES

Biwax Corp., 3445 Howard St., Skokie, Ill.
Cooper Co., D. C., 1467 S. Michigan Ave., Chicago, Ill.
DISTILLATION PRODUCTS INDUSTRIES, A Division of Eastman Kodak Co., Rochester 3, N. Y. ADV. PG. 91
du Pont De Nemours & Co., Inc., E. I., Wilmington 98, Del.
Glyco Products Co., Inc., 26 Court St., Brooklyn 2, N. Y.
Mastic Tile Corp. of America, Newburgh, N. Y.
Zophar Mills, Inc., 112-130 26th St., Brooklyn 32, N. Y.

WINDOWS—Mica

Ashville-Schoonmaker Mica Co., Inc., 62 Worth St., New York 13, N. Y.

WIRE—Slide, Calibrated

Barnes Development Co., 213 W. Baltimore Pike, Lansdowne, Pa.
Square Root Mfg. Corp., 391 Saw Mill River Rd., Yonkers, N. Y.

X-RAY DIFFRACTION APPARATUS

Bracke-Seib X-Ray Co., Inc., 293 Third Ave., New York 10, N. Y.
CENTRAL RESEARCH LABORATORIES, INC., Red Wing, Minn. ADV. PG. 118
Daylight Vacuum Products Co., 5207 N. Milwaukee Ave., Chicago 30, Ill.
Jarrell-Ash Co., 165 Newberry St., Boston 16, Mass.
North American Philips Co., Inc., 100 E. 42nd St., New York 17, N. Y.
Nucleonics & Radiological Developments Ltd., 77 King's Rd., London S. W. 3, England.
Picker X-Ray Corp., 25 S. Broadway, White Plains, N. Y.
St. John X-Ray Laboratory, Califen, N. J.
Twentieth Century Electronics, Ltd., Dunbar Works, Dunbar St., West Norwood, London, S. E. 27, England
VICTOREEN INSTRUMENT CO., 3800 Perkins Ave., Cleveland 14, Ohio. ADV. PG. Inside Front Cover
X-Ray Department of General Electric Co., 4855 Electric Ave., Milwaukee 1, Wis.

X-RAY EQUIPMENT—Industrial

BAR-RAY PRODUCTS, INC., 209 25th St., Brooklyn 32, N. Y. ADV. PG. 112
Bracke-Seib X-Ray Co., Inc., 293 Third Ave., New York 10, N. Y.
CANADIAN RADIUM & URANIUM CORP., 630 Fifth Ave., New York 20, N. Y. ADV. PG. 116
Dallons Labs., 5066 Santa Monica Blvd., Los Angeles, Calif.
Falk & Co., Ltd., M., 5 Victoria St., London, S. W. 1, England
HIGH VOLTAGE ENGINEERING CORP., 7 University Rd., Cambridge 38, Mass. ADV. PG. 20
Picker X-Ray Corp., 25 S. Broadway, White Plains, N. Y.
St. John X-Ray Laboratory, Califen, N. J.
Universal X-Ray Products, Inc., 1140 N. Western Ave., Chicago 22, Ill.
VICTOREEN INSTRUMENT CO., 3800 Perkins Ave., Cleveland 14, Ohio. ADV. PG. Inside Front Cover
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X-RAY TUBES

See Tubes, X-Ray

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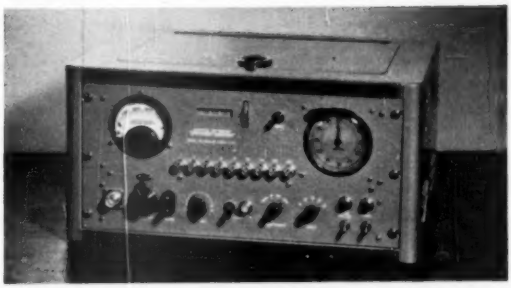

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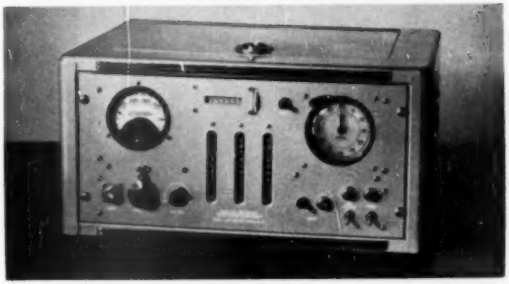

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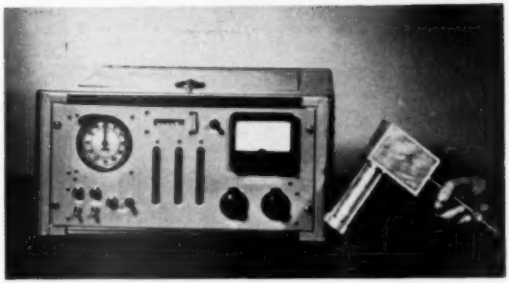

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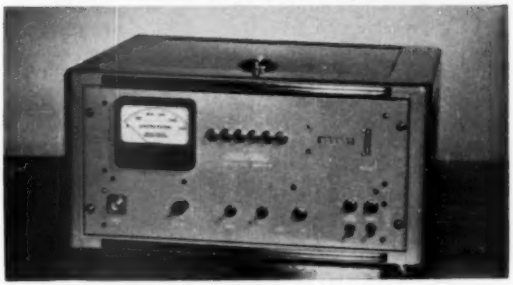

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